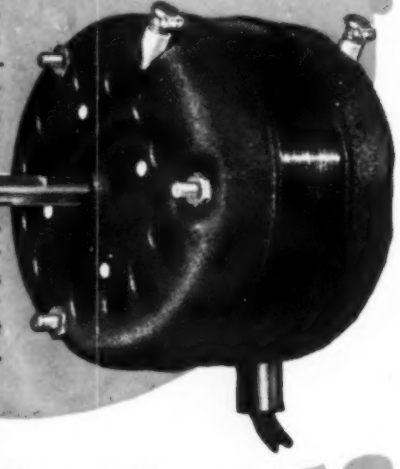

RADIO
NEWS
RADIO-ELECTRONIC
ENGINEERING
EDITION
PUBLIC LIBRARY
MAR 3 - 1947
W9RR DETROIT W9WZE
W9WZE
W9YQH
W9CYW
W9WKB
W7BG

DRIVE YOUR PRODUCTS to market with alliance MOTORS

ALLIANCE PHONOMOTORS
—POWR-PAKT MOTORS in shaded pole induction and split-phase reversible resistor types rated from less than 1/400th h. p. on up to /20th h. p. for powering valves, switches, controls, driv- turntables, fans, record changers and automatic devices.

NEW MODEL A shaded pole, induction-type Alliance otor for speeds from 500 to 1050 R.P.M. operates on 50 or cles at voltages up to 220, horse power, size 4⅝ x ches. Porous bronze, oilless- sleeve bearings. Open or enclosed construction. Ap- . 8 to 40 oz. in. full load ning torque, de- nding on stack ngth. Exceptionally quiet. For continuous or in- termittent duty. Runs clockwise or counter clockwise—not reversible.



SLOWER SPEEDS • LOWER CURRENT COSTS
QUIETER OPERATION • SMALLER SIZE

Here are four *big* advantages built into the new *Alliance Powr-Pakt* fan motors. Results are longer life — less repair — smoother performance. This new Alliance shaded pole fan motor reflects advanced engineering! Mass-produced at low cost. Write!

HEN YOU DESIGN—KEEP alliance MOTORS IN MIND

ALLIANCE MANUFACTURING COMPANY

Building this **A. M. SIGNAL GENERATOR** gives you valuable experience. Provides amplitude-modulated signals for test and experiment purposes.

RADIO SERVICING pays good money for full time work. Many others make $5, $10 a week EXTRA fixing Radios in spare time.

VETERANS
You can get this training right in your own home under G. I. Bill. Mail coupon for full details.

Learn RADIO by PRACTICING in Spare Time

You build this **SUPERHETERODYNE CIRCUIT** that brings in local and distant stations. You get practical experience putting this set through fascinating tests.

You build this **MEASURING INSTRUMENT** yourself early in the course—use it for practical Radio work on neighborhood Radios to pick up EXTRA spare time money!

with Big Kits of Radio Parts I Send You

Do you want a good-pay job in Radio—or your own money-making Radio Shop? Mail Coupon for a FREE Sample Lesson and my FREE 64-page book, "How to Be a Success in RADIO—Television, Electronics." See how N.R.I. gives you practical Radio experience at home—building, testing, repairing Radios with BIG KITS OF PARTS I send!

Many Beginners Soon Make Good Extra Money in Spare Time While Learning

The day you enroll I start sending EXTRA MONEY JOB SHEETS. You LEARN Radio principles from my easy-to-grasp, illustrated lessons—PRACTICE what you learn with parts I send—USE your knowledge to make EXTRA money fixing neighbors' Radios in spare time while still learning! From here it's a short step to your own *full-time* Radio Shop or a good Radio Job!

Future for Trained Men Is Bright in Radio, Television, Electronics

It's probably easier to get started in Radio now than ever before because the Radio Repair business is booming. Trained Radio Technicians also find profitable opportunities in Police, Aviation, Marine Radio, Broadcasting, Radio Manufacturing, Public Address work. Think of even *greater* opportunities as Television and Electronics become available to the public! Send for free books now!

Find Out What N.R.I. Can Do for You

Mail Coupon for Sample Lesson and my 64-page book. Read the details about my Course. Read letters from men I trained, telling what they are doing, earning. See how quickly, easily you can get started. No obligation! Just MAIL COUPON NOW in an envelope or paste it on a penny postal.
J. E. Smith, President, Dept. 7CR, National Radio Institute, Pioneer Home Study Radio School, Washington 9, D. C.

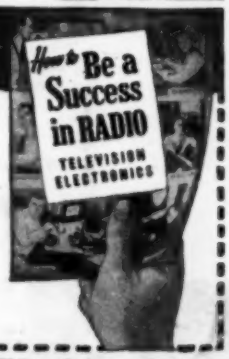
My Course Includes Training in
TELEVISION ★ ELECTRONICS
Frequency Modulation

BE A SUCCESS in RADIO
I Will Train You at Home

Sample Lesson FREE

Gives hints on Receiver Servicing, Locating Defects, Repair of Loudspeaker, I.F. Transformer, Gang Tuner, Condenser, etc., 31 illustrations. Study it—keep it—use it—without obligation! Mail Coupon NOW for your copy!

GET BOTH 64 PAGE BOOK SAMPLE LESSON **FREE**



Mr. J. E. SMITH, President, Dept. 7CR
National Radio Institute, Washington 9, D. C.

Mail me FREE, without obligation, Sample Lesson and 64-page book about how to win success in Radio and Television—Electronics. (No salesman will call. Please write plainly.)

Age.....

Name .....

Address .....

City .....Zone....State.....

APPROVED FOR TRAINING UNDER GI BILL

THE COVER: Part of the extensive array of communications equipment that will accompany the Gatti-Hallicrafters Expedition for use at the main base in South Africa.

First in radio

Average Paid Circulation over 130,000

RADIO NEWS

Reg. U. S. Pat. Off.

MARCH, 1947

FOR THE SERVICEMAN-DEALER

FOR THE AMATEUR

OF GENERAL INTEREST

DEPARTMENTS

185 North Wabash Ave., Chicago 1, Ill.
VOLUME 37 • NUMBER 3

RADIO NEWS is published monthly by the Ziff-Davis Publishing Company, 185 N. Wabash Ave., Chicago 1, Ill. Subscription Rates: in U.S. and Canada $4.00 (12 issues), single copies 35 cents; in Mexico, South and Central America, and U. S. Possessions, $4.00 (12 issues); in British Empire, $5.00 (12 issues)—all other foreign countries $5.00 (12 issues). Subscribers should allow at least 2 weeks for change of address. All communications about subscriptions should be addressed to: Director of Circulation, 185 N. Wabash Ave., Chicago 1, Ill. Entered as second class matter March 9, 1938, at the Post Office, Chicago, Illinois, under the Act of March 3, 1879. Entered as second class matter at the Post Office Dept., Ottawa, Canada. Contributors should retain a copy of contributions and include return postage. Contributions will be handled with reasonable care but this magazine assumes no responsibility for their safety. Accepted material is subject to whatever revisions and by-line changes that are necessary. Payment made at our current rates, covers all authors', contributors', or contestants' rights, title, and interest in and to accepted material, including photos and drawings.

Going places (AGAIN)

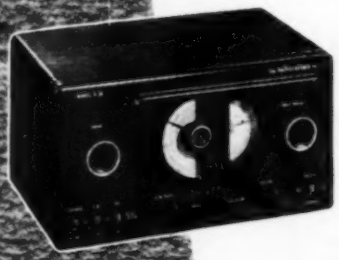
hallicrafters

Hallicrafters famous radio equipment, sold and distributed around the world before the war and used with superb effectiveness in every theater during the war is once again on the move. Watch for latest details of the Gatti-Hallicrafters mobile radio equipped expedition to the Mountains of the Moon in deepest Africa—a new and exciting test for the ingenuity of hams and the performance of Hallicrafters equipment.

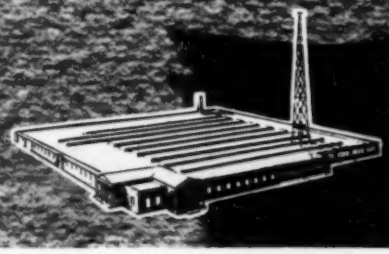
3 GREAT RECEIVERS designed and built for hams who are going places, too

***Model* SX-42** Described by hams who have operated it as "the first real postwar receiver." One of the finest CW receivers yet developed. Greatest continuous frequency coverage of any communications receiver—from 540 kc to 110 Mc, in six bands. FM-AM-CW. 15 tubes. Matching speakers available. **$275.00**

***Model* S-40A** Function, beauty, unusual radio performance and reasonable price are all combined in this fine receiver. Overall frequency range from 540 kc to 43 Mc, in four bands. Nine tubes. Built-in dynamic speaker. Many circuit refinements never before available in medium price class. **$89.50**



***Model* S-38** Overall frequency range from 540 kc to 32 Mc, in four bands. Self contained speaker. Compact and rugged, high performance at a low price. Makes an ideal standby receiver for hams. CW pitch control is adjustable from front panel. Automatic noise limiter..... **$47.50**



Skytone AM-FM-SW Broadcast Receiver

hallicrafters RADIO

THE HALLICRAFTERS CO., MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.

Sole Hallicrafters Representatives in Canada: Rogers Majestic Limited, Toronto-Montreal

IT'S FADA for '47

New!

The Radio of TO-MORROW . . . TO-DAY!

FADA faces '47 with the greatest line of radio receivers in the history of radio. Each model is a gem of engineering achievement . . . new clarity of reception, new beauty of design, new extra-durability. There is a FADA model for every room.

You can always depend upon the sales-appeal of FADA — the Radio of Tomorrow . . . Today!

MODEL 659

Short wave version of Model 652. 2 Wave Band Superheterodyne. American and foreign reception. Covers American broadcast and international short wave down to 16 meters.

MODEL P82

Tri-power portable Superheterodyne with Hi-Gain tuned RF stage in rich two-tone simulated leather covered wood cabinet. 5 tubes plus rectifier tube.

MODEL 1000

AC-DC Superheterodyne in beautiful gem-like "Fada-lucent" cabinets. Five Tubes plus Rectifier Tube.

FADA *Sensive-Tone*

FADA 5-tubes—plus-rectifier-tube models are equipped with the new FADA "Sensive-Tone" ...assuring greater sensitivity and clearer reception.

MODEL 602

New Superheterodyne AC Table Model Radio Phonograph Combination with Automatic Record Changer in a Cabinet of Beautiful Mahogany Veneers.

YOU CAN ALWAYS DEPEND ON

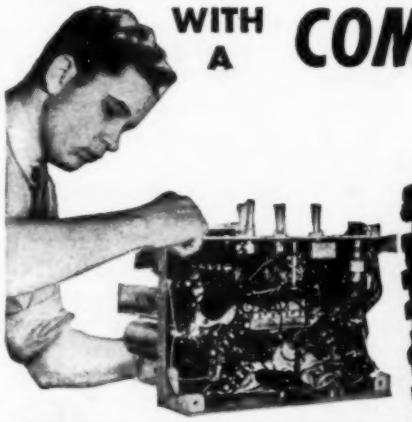
FADA Radio

Famous Since Broadcasting Began!

FADA RADIO AND ELECTRIC COMPANY, INC., LONG ISLAND CITY, N. Y.

NOW SPRAYBERRY RADIO TRAINING GIVES YOU 8 BIG KITS OF RADIO EQUIPMENT

WITH A COMPLETE 6 TUBE SUPER-HETERODYNE RECEIVER



YOU LEARN RADIO SERVICING THROUGH INTENSIVE "SHOP-BENCH" PRACTICE

YOU DO EXPERIMENTS, CONSTRUCTION, TROUBLE-SHOOTING

I'll show you how to perform over 175 instructive Experiments—how to build countless Radio Circuits. You'll learn a new, fast way to test Radio Sets without mfg. Equipment.

I give you a fine, moving-coil type Meter Instrument on Jewel Bearings—with parts for a complete Analyzer Circuit Continuity Tester. You learn how to check and correct Receiver defects with professional accuracy and speed.

You'll get valuable experience and practice building this Signal Generator and multi-purpose Tester. Makes a breeze out of fixing Radios and you don't have to spend money on outside, ready-made equipment.

Soldering, wiring, connecting Radio parts . . . building circuits with your own hands—you can't beat this method of learning. When you construct this Rectifier and Filter, Resistor and Condenser Tester, etc., you get a really practical slant on Radio that leads to a money-making future.

HERE'S THE LATEST, SIMPLEST WAY TO TRAIN at HOME for a GOOD LIVING in RADIO-ELECTRONICS & TELEVISION

I train your *mind* by putting you to work with your *hands* on a big 6-Tube Superheterodyne Receiver. And, believe me, when you get busy with real Radio Parts — 8 big Kits of them — you really LEARN Radio and learn it RIGHT! You get the practical stuff you need to be *useful* in Radio, and that's what it takes to make money. You don't have to worry about what to do with these 8 Kits of Parts. Step by step, I show you how to build circuits, test, experiment, trouble-shoot. And you don't need any previous experience. The Sprayberry Course starts right at the beginning of Radio! You can't get lost! Simplified lessons, coupled with real "Shop" practice, makes every subject plain and easy to understand and remember.

A BUSINESS OF YOUR OWN . . . OR A GOOD RADIO JOB

Soon after you begin Sprayberry Training, I'll send you my sensational BUSINESS BUILDERS. You'll find out how to get and do neighborhood Radio repair jobs for nice profits and rich experience while learning. This sort of work can easily pave the way for a Radio Service business of your own. But with Sprayberry Training, you're not limited. You can swing into any one of the swiftly expanding branches of Radio-Electronics INCLUDING Radio, Television, FM, Radar, Industrial Electronics. Be wise! Decide now to become a fully qualified RADIO-ELECTRONICIAN. Get full details about my Training at once! Mail coupon below for my 2 big FREE Books.

SEND FOR THESE FREE BOOKS

"How to Read Radio Diagrams and Symbols"

Here's a valuable and wonderfully complete new book which explains in simple English how to read and understand any Radio Set Diagram. Includes translation of all Radio symbols. Send for this volume at once! It's free! Along with it, I will send you another Big Free book describing in detail my Radio-Electronic Training.

MAIL COUPON TODAY!

SPRAYBERRY ACADEMY OF RADIO

F. L. Sprayberry, President, Room 2537, Pueblo, Colorado

Please rush my FREE copies of "How to MAKE MONEY in RADIO, ELECTRONICS and TELEVISION," and "HOW to READ RADIO DIAGRAMS and SYMBOLS."

Name ..... Age .....

Address .....

City ..... State .....

(Mail in envelope or paste on penny postcard)

For the RECORD.

BY THE EDITOR

LEADERS responsible for the success of commercial television as it gathers momentum in 1947 must decide right now that "good taste" in programming might well be the only key to the door of average Mr. and Mrs. TV Prospect.

Commercial AM programming, in many cases, has failed to maintain its original prestige in the eyes of the public. Commercials have gone from bad to worse and as far as education is concerned, AM today has little to offer in educational prestige. If this germ is absorbed by television program writers and directors, we shudder to think of what future generations will glean from that plague. We don't mean that efforts are not being made to properly launch television to the public, but we do feel that the press in general is not fully cognizant of the danger of TV getting off to a bad start.

According to best estimates, there will be better than 75 television stations offering program service by the end of the present year. To date the FCC has granted more than 47 construction permits in 22 of the most populous states throughout the country. In addition, there are now 6 commercial television stations on the air. Add to this the 25 or 30 applications on file at the FCC and we find that television is growing by leaps and bounds.

There were many factors during the past year which hindered the expected progress of television. They included such familiar stumbling blocks as strikes, material shortages, etc. In spite of these difficulties, much progress was made. Some even claim that 1946 was a good year for television.

It is quite possible that a half million folks will own television sets by 1948. Television during the coming presidential campaign will make it possible for all candidates to be seen as well as heard. We'll bet that many a housewife will vote for her favorite politician if he has a bit more glamour than his opponent.

Many of you old timers remember back in 1924 when radio had the same opportunity during that presidential campaign as television will have in 1948.

Many companies are already producing television receivers. Most of them are table models but the big stuff will come later when wood for cabinets becomes more plentiful. These manufacturers have done a great job, even though they did not reach the goal of nearly 200,000 sets which they had set for 1946. If it were not for material shortages, chances are that they certainly would have hit the jack pot.

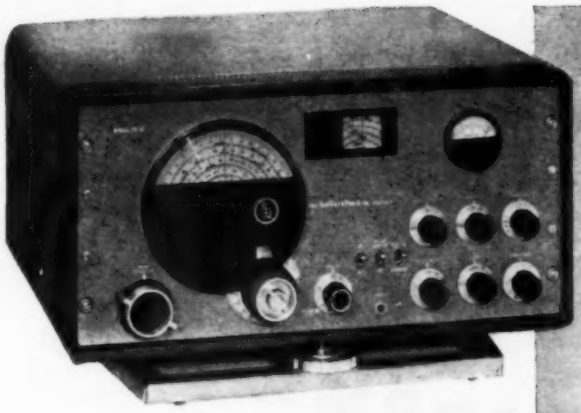
Another handicap still to be overcome at this writing is the restriction on the building of satisfactory quarters for television stations. This includes both transmitter houses as well as studios and offices. It is, however, quite likely that the controls will be dropped in the very near future.

In a recent talk Mr. Edgar Kobak, president of the Mutual Broadcasting Company, pointed out that, "We must not forget our responsibility as licensees, or we may wind up not running this television business. Television is going to have a great deal more to do than the movies or radio in bringing understanding among people . . . and with that responsibility we have got to be very careful that we do not misuse it." Mr. Kobak has really got something there!

It won't be very long until our youngsters will be sitting in the living room tearing their hair out as Dick Tracy approaches the gunfire of six desperados. It will be very easy for television to influence these children. Radio programming at present is surely bad enough but salt will be poured into the wound if TV sacrifices its prestige in exchange for revenue without due consideration for the type of material that will be televised.

On the other hand, television can and should set its sights very high as far as good taste is concerned. By so doing, it will expand at a healthy rate. There will be no time to experiment with public opinion unless telecasters can assure their televiewers that programs of high caliber are already programmed or are contemplated in the months to follow.

Television schools too, have a golden opportunity to campaign for decency and good taste in television programs. Yes, 1947 will be the "proving ground" for television. Many will butcher their opportunities while other organizations will band together to insist that good taste prevails. We'll bet (with our tongue in our cheek) on the latter. . . . . O.R.



Order Your Communications Receiver *from* ALLIED!

IMMEDIATE DELIVERY

on most models

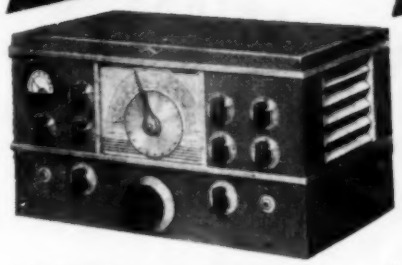
Time Payments

Trade-Ins Accepted

NEW!

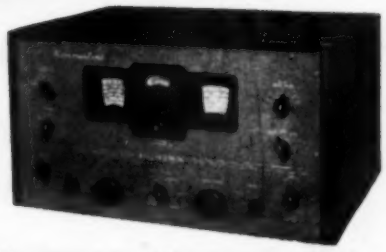
HALLICRAFTERS SX-42

Here's the NEW SX-42—the receiver that sets a new standard in radio performance. Covers everything: Frequency range of 540 KC. to 110 MC. brings you high-fidelity broadcast reception—world-wide Short-wave coverage—PLUS true high-fidelity FM broadcast reception (all FM frequencies), and hi-fi phono reproduction. The new SX-42 is brilliantly designed to bring you more features, more operating thrills than you've ever thought possible. Wide-vision no-glare dials, AM-FM signal level meter, six-position selectivity control, dual IF system, separate sensitivity and volume control, NEW SIMPLIFIED controls for family use. Designed for top-flight reception—in the home, or for Amateur and Commercial communication work.
Net, less Speaker..... **$275.00**



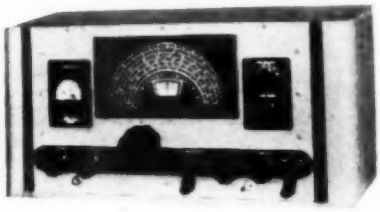
NATIONAL NC-2-40D

One of National's top receivers. Covers 490 KC. to 30 MC. range in 6 tuning bands. Has definite, accurate calibration for all bands. Features efficient single-dial control. Famous for its stable high frequency circuits. Frequency drift is reduced to a negligible value by temperature compensation. Has automatic band-in-use indicator. Wide-range adjustable series-valve-noise limiter. Flexible crystal filter. Special r.f. coupling circuits maintain full sensitivity.
Net, less Speaker..... **$225.00**
Speaker in matching cabinet, *Net*..**$16.44**



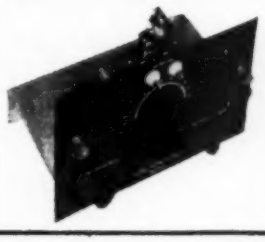
HAMMARLUND HQ-129-X

Designed to meet the most critical demand of professional operators. Full range, .54 to 31 MC. accurately calibrated. Has 4 calibrated Ham bands and one arbitrary scale. Variable selectivity crystal filter. Low-drift beat oscillator for code and locating stations. Antenna compensator. Voltage regulation. Automatic noise limiter. Compensated oscillator to reduce drift during warm-up. Earphone jack. Three i.f. amplifier stages. Two audio stages. Speaker supplied in matching metal cabinet.
Net, with Speaker..... **$173.25**



THE RME 45

The famous RME 45 Receiver delivers peak reception on all frequencies—550 to 34,000 KC. Features full-vision calibrated dial using a single control for two-speed tuning. Includes five Amateur bands with ample band-spread. Has DB-calibrated signal level meter; 5-step variable crystal filter; Automatic Noise Suppression; stable, variable-pitch beat oscillator, and a host of other features. Housed in handsome streamlined metal cabinet with matching speaker.
Net, with Speaker..... **$198.70**



SPECIAL! NEW 2-METER TRANSCEIVER KIT

For the new 2-meter band! Uses 6N4 as mod.-osc. in transmit position and as super-regen. det. in receive position; 7C5 as mod. in transmitting, and as power audio amp. in receiving. Supplies current for single button carbon mike; has output transformer for coupling to speaker or headphones. Requires 250 v. at 75 ma., 6.3 v. at .65 amp. for power. Kit when completed measures 6" x 5" x 9". Includes all necessary parts and tubes (less mike, speaker and power supply). No. 83-220. **NET**..... **$18.95**
Power Supply Kit. Includes all parts necessary to build power supply for transceiver. No 83-371. **NET** **$10.25**

Other Communications Receivers

Hallicrafters S-38	$47.50	RME-84	$98.70
Hallicrafters S-40A	89.50	RME VHF-152 Converter	86.60
Hallicrafters S-41G	36.75	RME DB-20 Preselector	68.20
National NC-46	97.50	National HRO	274.35
NC-46 Speaker	9.90	Hammarlund SPC-400X	342.00

Net F. O. B. Chicago. Prices subject to possible change.

FREE! ALLIED'S Latest Catalog

ALLIED RADIO

Everything in Radio and Electronics

ALLIED RADIO CORP., D. L. Warner, W9IBC
833 W. Jackson Blvd., Dept. 1-CC-7
Chicago 7, Illinois

☐ Enter order for.....Model.....

☐ Enclosed $.....☐ Full Payment
☐ Part Payment (Balance C.O.D.)

☐ Send full information on Communication Receivers and Time Payment Plan, without obligation.

☐ Send FREE 1946 ALLIED Catalog.

Name.....

Address.....

City.....*Zone*.....*State*.....

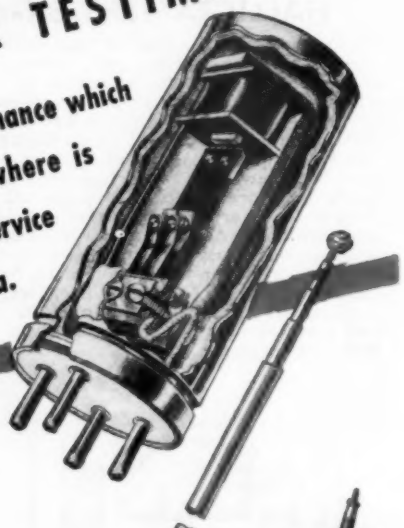
STANDARD OF COMPARISON

RADIART

"...ELEVEN YEARS OF TROUBLE-FREE PERFORMANCE"

A typical RADIART VIBRATOR TESTIMONIAL

A typical example of the testimonials to Radiart performance which come in to us regularly from Radiart users everywhere is contained in a recent letter from a Mid-Western service man, Mr. W. E. Hopper, of North Vernon, Indiana.



Back in 1935, Mr. Hopper purchased and installed a Radiart Vibrator, type 3315. On October 14, 1946, eleven years later, Mr. Hopper wrote in to order a new Radiart to replace the original which had finally worn out ***AFTER ELEVEN YEARS OF TROUBLE-FREE PERFORMANCE!***

This amazing record is only one of the many in our files attesting to the superiority of Radiart products. Designed to exacting specifications, of the highest quality materials, Radiart Vibrators, Vipowers and Aerials are as perfect as modern manufacturing methods can make them.

Ask to see these quality lines at your jobbers today or write for new illustrated Vibrator Guide and Catalog.

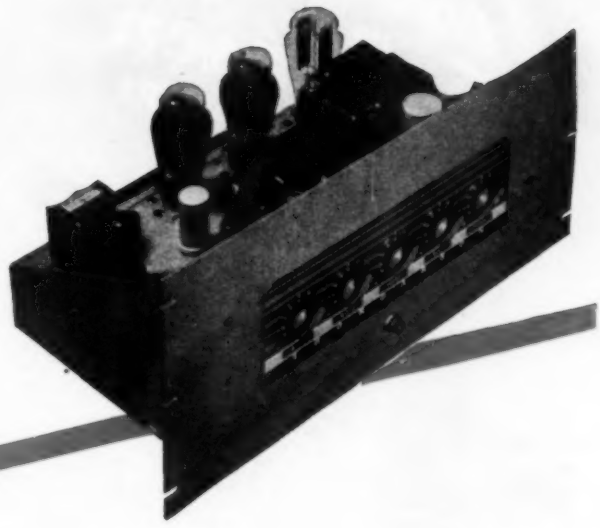
ELECTRONIC DISTRIBUTOR

MAGUIRE

936 N. MICHIGAN

THORDARSON
AMPLIFIERS

Here is an amplifier line designed for true, brilliant sound reproduction. The last word in amplifier quality, these precision-built units are backed by 52 years of transformer manufacturing experience and 31 years of audio pioneering . . . See them at your jobbers today.



MEISSNER
ANALYST

The modern service instrument. Designed to handle the receivers of today, yesterday and tomorrow with equal facility. Tests by the signal-tracing method . . . fastest, most reliable method to date . . . See it at your jobbers today.

MEISSNER—THORDARSON RADIART
PRODUCTS IN PHOTO-FACT FOLDERS

EXPORT ADDRESS, SCHEEL INTERNATIONAL, INC.
4237-39 N. LINCOLN AVENUE, CHICAGO 18, ILLINOIS
CABLE HARSCHEEL

AND INDUSTRIAL SALES DEPARTMENT

INDUSTRIES inc.
AVENUE, CHICAGO 11, ILLINOIS

Grasp the NEW OPPORTUNITIES in RADIO ELECTRONICS AND TELEVISION NOW!

Modern Radio — FM Broadcast and Reception — Television — Industrial Electronics; Power, Control, Communications — new equipment and methods demand new technical ability and experience. Keep up to date with the latest.

MODERN RADIO EQUIPMENT FOR YOU TO USE AND KEEP

The very essence of National Shop Method Home Training is EXPERIENCE. You get actual experience by working with modern Radio and Electronic equipment—building many types of circuits. You may build a fine, long distance MODERN SUPERHETERODYNE, signal generator, miniature radio transmitter, audio oscillator, etc.—many other standard actual operating pieces of equipment—conduct cathode ray and other experiments. This practical work advances with your training—YOU LEARN BY DOING!

Shop Method Home Training

By a Real Established Resident School with its own FM Studios, Shops and Laboratories.

TRAIN WITH ADVANCED TECHNIQUE

The good jobs in Radio Electronics now go to the men who are equipped to handle them. It takes training and experience. National Schools, one of the oldest and largest trade schools in the country, makes it possible for you to get this training right in your own home IN YOUR SPARE TIME.

National maintains modern resident training Studios, Shops and Laboratories where instructors and engineers are working constantly to improve training methods. SHOP METHOD HOME TRAINING is a logical extension of this practical system.

A FREE lesson that shows you how practical and systematic this new training method is will be sent you without obligation. You may keep and use this lesson to prove to yourself just how practical National Training really is.

Get one of the many NEW JOBS that demand new techniques and methods in Modern Radio. Get your share of the NEW BUSINESS that servicing the new sets and equipment demands. Experts agree that Radio, Television and Electronics present opportunities much greater than ever before!

Radio is expanding with far-reaching improvements in reception. No one knows yet how great the Television market will be. Electronics will touch almost every walk of life—in industry and in the home.

TURN YOUR INTEREST IN RADIO INTO A CAREER THAT WILL ASSURE YOU SUCCESS AND SECURITY.

FIND OUT WHAT NATIONAL TRAINING CAN DO FOR YOU

Where do you stand today in modern industrial progress? What does the future hold for you? You owe it to yourself to investigate this opportunity. With National Training YOU GET AHEAD FAST—you may step into a good position or start a business of your own, with little capital, **even before you complete your National Course.**

Fit yourself for a career of independence, good earnings, success and security in one of the fastest growing fields in industry. For full information, just send your name and address on the coupon and mail it TODAY.

APPROVED FOR TRAINING UNDER GI BILL

Get This Book FREE

This big book presents the facts about the field of Electronics and your opportunities in it together with full information about the advanced National Training. Read it and make up your own mind that National Training will equip you for a great future. No salesman will call on you from National. The book is FREE with your sample lesson. Clip and mail the coupon TODAY!

See What National Training Has Done For These Men

National Shop Method Home Training wins good jobs, independence and security. Take the word of National men who have established records in their favorite Radio, Television, or other branches of Electronics.

From O. K. Ivey, Washington, D. C., comes this endorsement: "I believe National offers the best course to be had . . . Keep up the good work."

Here's a statement from R. R. Wright, Blackfoot, Idaho: "Due to my training at National I was selected to instruct in the laboratory work of Navy and Marines."

Clifford Hannah, Portage La Prairie, Manitoba, Canada, writes: "My training has brought results as I'm in line for another raise thanks to National's encouragement and thorough training."

Joseph Michel, Jr., Granite City, Illinois, writes: "I am enthused with National training. I am now earning $225 a month as a radio operator and technician and $20 a week more in my shop at home.

Read what other enthusiastic students have written about National Training in the big 40 page book we will send you.

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA EST. 1905

MAIL OPPORTUNITY COUPON FOR QUICK ACTION

National Schools, Dept. 3-RN
4000 South Figueroa Street, Los Angeles 37, California

(Mail in envelope or paste on penny post card)

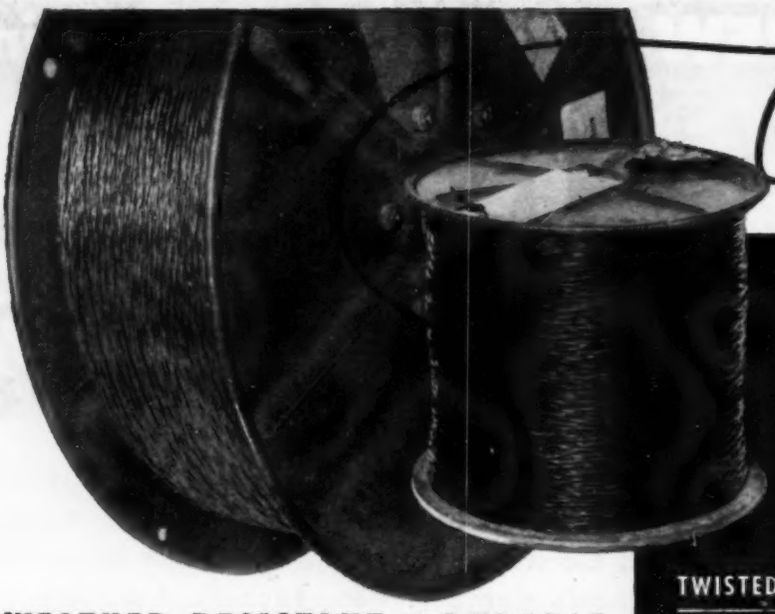
Mail me FREE the two books mentioned in your ad including a sample lesson of your course. I understand no salesman will call on me.

NAME ..... AGE.....

ADDRESS .....

CITY ..... STATE.....
Include your zone number

☐ **Check here if veteran of World War II**



Wire

Plastic Coated Assault Wire

ON ORIGINAL STEEL REELS

TWISTED 2 CONDUCTOR 20-7 STRAND TINNED

★ WEATHER RESISTANT ★ DURABLE
★ LIGHT WEIGHT ★ FLEXIBLE

Available for Immediate Delivery at the following prices:

2,000 ft. steel reels (individually boxed)	Per 1000 ft.	**$10.00**
4,000 ft. pay out wooden reels (packed 2 reels per box)	Per 1000 ft.	**9.00**
10,000 ft. steel reels	Per 1000 ft.	**7.50**
20,000 ft. steel reels (same wire but single conductor)	Per 1000 ft.	**3.00**

The Above Wire is in Stock at these Jobbers:

All-State Distributing Co.
Dallas, Texas

Alme Radio Company
Philadelphia, Pa.

American Radio Corp.
Dover, New Hampshire

H. C. Baker Sales Co.
Roanoke, Va.

Bakersfield Radio Supply
Bakersfield, Calif.

Bessemer Radio Supply Co.
Bessemer, Ala.

Boe Distributing Co.
Dubuque, Iowa

Cabill Electric Co.
Jackson, Miss.

Chambers Radio Supply Co.
Cincinnati, Ohio

Chase Hunt LaMont Co.
Springfield, Mass.

James W. Clary Company
Birmingham, Ala.

Commercial Radio & Sound
Henryetta, Okla.

Crabtree Wholesale Radio
Dallas, Texas

Crescent Radio Supply
Glasgow, Ky.

Denison Radio Supply
Denison, Texas

Electronic Distributors
Lexington, Ky.

Fentriss Sound Equip. Co.
Oklahoma City, Okla.

Fitzpatrick Elect. Co.
Muskegon, Mich.

Fulton Radio Supply Co.
Jackson, Mich.

Geophysical Supply Co.
Houston, Texas

Harrison Equip. Co.
Houston, Texas

Herman Radio Supply Co.
Miami, Fla.

Louis M. Herman Co.
Boston, Mass.

Houston Radio Supply Co.
Houston, Texas

KLA Lab. Inc.
Detroit, Mich.

Lurtz Electric Company
Belleville, Ill.

March Radio Supply
Milwaukee, Wisc.

Mid West Associated Dist.
Rockford, Ill.

Morten Dist. Co., Inc.
Fresno, Calif.

Murphy Sales Co.
Buffalo, N. Y.

Northwest Electronics
Spokane, Wash.

Peerless Electronic Equip. Co.
Louisville, Ky.

Pioneer Radio Supply Corp.
Cleveland 15, Ohio

Radio & Refrigeration Supply Co.
Cincinnati, Ohio

Radio & Television Equip. Co.
Santa Ana, Calif.

Radio Equip. Co.
Lexington, Ky.

Radio Products Sales
Denver, Colo.

Radio Products Sales
Los Angeles, Calif.

Radio Service Lab.
Manchester, N. H.

Radio Wire & Television Inc.
Boston, Mass.

Reid Dist. Co.
Birmingham, Ala.

R. G. Schelli & Co.
Hartford, Conn.

H. E. Sorenson Co.
Des Moines, Iowa

Sound Electronics Supply
Portsmouth, Ohio

Southeastern Radio Parts Co.
Atlanta, Ga.

Southern Radio Supply
Little Rock, Ark.

Southwest Radio Supply
Dallas, Texas

Thiele Winslow Co.
San Antonio, Texas

Toy & Novel
Yakima, Washington

Van Sickle Radio Supply
Indianapolis, Ind.

David White Radio Supply Co.
Little Rock, Ark.

Williamsport Radio Supply
Williamsport, Pa.

Other Wire Available from Wells

Field wire, No. 18 stranded, 7 strands (4 steel 3 copper) 2 conductor, rubber-covered, weather-proof, 2000 ft. reels	Per 1000 ft.	**$12.00**
Field wire, same as above but single conductor, 2000 ft. reels	Per 1000 ft.	**6.00**
Aerial wire, No. 12 Phosphor Bronze, 7 strands No. 20	Per 1000 ft.	**20.00**
Aerial wire, No. 18 copper weld, solid, 3000 ft. reels	Per 1000 ft.	**7.50**
Single conductor, No. 20 shielded, overall braid, 1000 ft. reels	Per 1000 ft.	**25.00**
Single conductor, No. 20 shielded, stranded, outside bare shield, 1000 ft. reels	Per 1000 ft.	**22.50**
Single conductor, ANJC 48 No. 20 stranded, glass braid lacquered, 1000 V. insulation, 2000 ft. reels	Per 1000 ft.	**12.00**
Single conductor, No. 20 stranded, glass braid lacquered, 3000 V. insulation (for transmitters) 1000 ft. reels	Per 1000 ft.	**16.00**

WELLS SALES, INC.

Jobbers write for Wire Bulletin 110
Send your Wire Requirements to WIRE DIVISION

4717 W. MADISON ST., DEPT. R-3, CHICAGO 44, ILL.

HQ-129-X

Choice of THOUSANDS

Hams are pretty shrewd individuals when it comes to selecting the gear they use. Many thousands knew what they wanted — they're using HQ-129-X receivers on the air every day. That, we believe, is one of the finest endorsements any product can achieve. Materials are still hard to get but hundreds of HQ-129-X's are being shipped every month.

36 YEARS OF KNOW HOW

BACKED BY

SEE THE HQ-129-X AT YOUR DEALER'S

THE SIGN OF QUALITY
ESTABLISHED 1910

HAMMARLUND

THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., NEW YORK 1, N.Y.
MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

FIGURE IT OUT FOR YOURSELF . . .

WHAT ARE THESE FEATURES OF

RIDER MANUAL VOL. XV

WORTH TO YOU?

What, in dollars-and-cents, is it worth to you, to have the services of Volume XV at your fingertips; this year, next year—for as long as the receivers produced during 1946 keep coming to your shop for repair?

What is the cash value of the time-saving benefits you will get from the exclusive features of this latest Rider Manual? (Volume I is still paying profits to servicemen who bought it sixteen years ago!)

Below are highlights of Volume XV features. Figure it out for yourself. What are they worth to you? As supply is limited, order Volume XV today.

RIDER MANUAL
VOLUME XV — JUST OUT

2000 Pages (Plus 150 page "How It Works")

The greatest single volume of Rider Manual yet published! Nowhere else will you find anything to equal Volume XV in completeness and helpfulness. Nowhere else will you find the wealth of vital servicing data—receiver schematics, voltage data, alignment data, resistance values, chassis layouts and wiring, and trimmer connections for 1946 receivers. Nowhere else will you find such authoritative data so complete and so systematically bound in one volume, ever ready, year after year for quick, easy reference.

That's why, for seventeen years the experience of successful servicemen throughout the world has proved, "You Can't Go Wrong With a Rider Manual."

RIDER MANUALS—IN 15 VOLUMES

Volume XV	$18.00
Volumes XIV to VII each volume	15.00
Volume VI	11.00
Abridged Manuals I to V (1 vol.)	17.50
Record Changers and Recorders	9.00

"clarified schematics"

"Clarified schematics" do a job which you have had to do on every multi-band receiver and combination set coming into your shop. "Clarified schematics" break down the composite diagrams of hundreds of complicated multiband receivers, providing you with exclusive, individual schematics of each and every circuit as it exists with each turn of the wave band or equipment switch. With a "clarified schematic" before you, you save the time heretofore spent tracing out an original schematic to find which components are in operation under different positions of the wave band switch. We have saved this time for your shop, by doing it for you in our laboratories. On this one "plus" service we have spent tens of thousands of dollars in order to save you hundreds upon hundreds of hours each year.

WHAT'S IT WORTH TO YOU? . . .

SEPARATE BOOK — "HOW IT WORKS"

Accompanying each copy of Volume XV is the 150 page book "How It Works," a practical guide to the theories of operation of the new technical features of the latest receivers. It explains and illustrates the functions of those "gimmicks" and "gadgets" which cause time-wasting headaches when not recognized and understood by the serviceman.

WHAT'S IT WORTH TO YOU? . . .

'HAM" COMMUNICATION RECEIVERS

All popular "Ham" sets are covered in Volume XV. This information opens up a profitable market for the competent serviceman who can now offer "hams" the benefits of a *local* alignment service.

WHAT'S IT WORTH TO YOU?

SCOTT RECEIVERS

Volume XV brings you complete information on all Scott receivers. "Clarified schematics" on these sets break down even the control switching circuits.

WHAT'S IT WORTH TO YOU?

MAGNAVOX RECEIVER-AMPLIFIERS

Volume XV is the only place where you will find a complete compilation of the various receiver-amplifier combinations produced by Magnavox during the ten years between 1937 and 1946.

WHAT'S IT WORTH TO YOU?

RECORD PLAYER COMBINATIONS

Maximum coverage and all pertinent information on record players and changers in post-war combinations.

WHAT'S IT WORTH TO YOU?

YEAR AFTER YEAR, AFTER YEAR

RIDER MANUALS

Pour Out Profits For Servicemen

JOHN F. RIDER PUBLISHER, INC. • 404 4th AVENUE • NEW YORK 16, N. Y.

Export Div.: Rocke-International Corp., 13 E. 40 St., N. Y. C. Cable: ARLAB

RIDER RADIO BOOKS KEEP YOU IN TOUCH WITH SUCCESS

Inside the Vacuum Tube
Solid concept of theory and operation $4.50

Understanding Microwaves
Provides foundation for understanding 6.00

Radar
Entertaining, revealing, in lay language 1.00

The Cathode Ray Tube at Work
Accepted authority on subject . . . 4.00

Frequency Modulation
Gives principles of FM radio . . . 2.00

Servicing by Signal Tracing
Basic Method of radio servicing . . 4.00

The Meter at Work
An elementary text on meters . . . $2.00

The Oscillator at Work
How to use, test and repair 2.50

Vacuum Tube Voltmeters
Both theory and practice 2.50

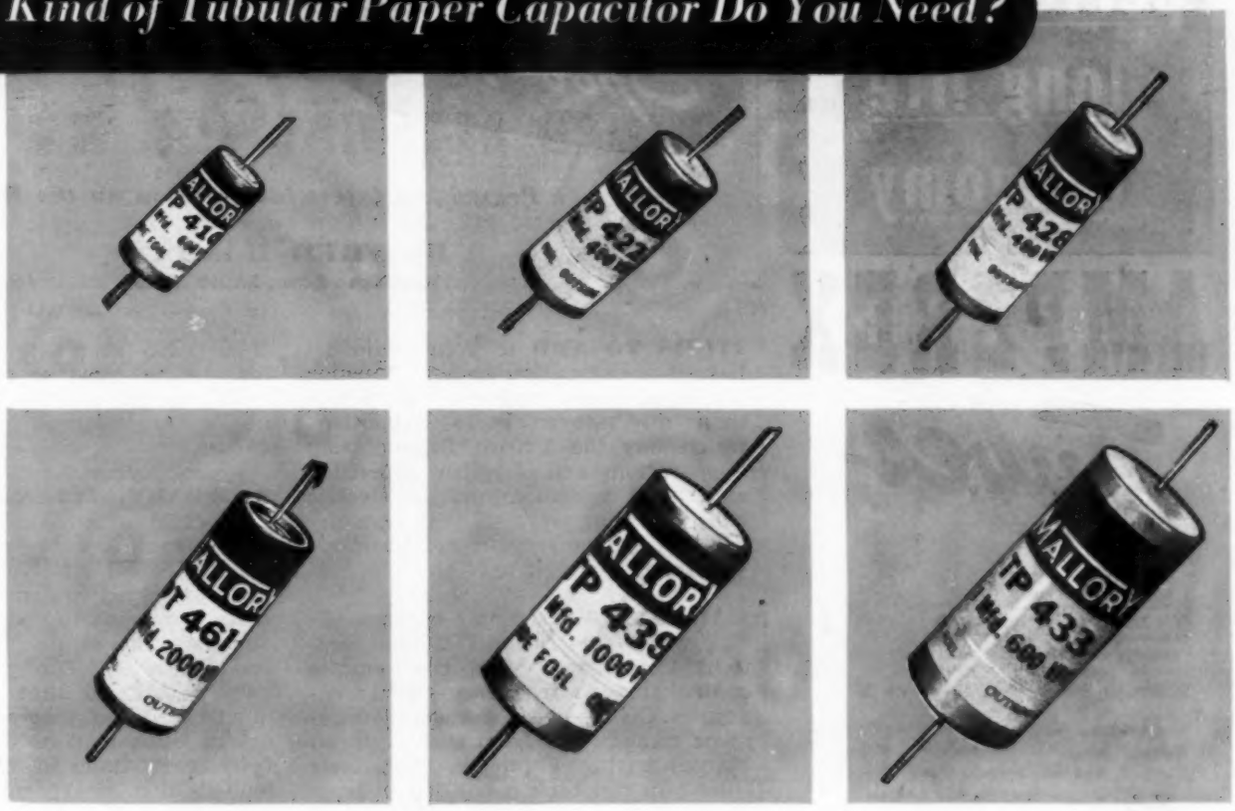
Automatic Frequency Control Systems
—also automatic tuning systems . . . 1.75

A-C Calculation Charts
Two to five times as fast as slide rule . 7.50

Hour-A-Day-with-Rider Series—
On "Alternating Currents in Radio Receivers"
On "Resonance & Alignment"
On "Automatic Volume Control"
On "D-C Voltage Distribution" $1.25 each

This new Rider Book, soon to be announced, will be of lasting usefulness to everyone interested in any phase of radio.

What Kind of Tubular Paper Capacitor Do You Need?



The MALLORY Line of capacitors is really complete

MALLORY makes 75 different paper tubular capacitors to supply your "every need" and for your convenience. They range in rating from 400 volts to 1600 volts—and in size from ⅜" x 1" to 1¼" x 2½".

These paper tubulars are divided into two broad categories—wax impregnated and oil impregnated. Both are hermetically sealed to provide against atmospheric penetration. Both are carefully factory-tested so you get *all* the quality that Mallory puts into them.

Get the complete story from your Mallory Distributor or from the Mallory Catalog.

You save a lot of time if you check the Mallory Catalog for replacement parts as you need them. Do you have a copy? If not, see your Mallory Distributor.

YOU EXPECT MORE AND GET MORE . . . FROM MALLORY

P R MALLORY & CO Inc

MALLORY

VIBRATORS . . . VIBRAPACKS® . . . CAPACITORS . . . VOLUME CONTROLS . . . SWITCHES . . . RESISTORS . . . FILTERS . . . RECTIFIERS . . . POWER SUPPLIES.

®Reg. U. S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Spot Radio News

★ *Presenting latest information on the Radio Industry*

By FRED HAMLIN
Washington Editor, RADIO NEWS

ITEMS TO ADD to your radio believe-it-or-nots; "radaranges," which can cook faster and more efficiently than any stove; radio hypnotism, which has the British Broadcasting Corporation and English television experts in a dither, and an electric baby sitter far more efficient than any you can engage in your neighborhood —as what wouldn't be?

RADARANGES recently became official when the Federal Communications Commission gave the remote-control stoves a frequency—2450 megacycles. On the heels of this announcement comes word from the Raytheon Manufacturing Company, that tests show you can cook a hot-dog in from eight to ten seconds, gingerbread and biscuits in 29 seconds, hamburgers and onions in 35 seconds, and frozen foods without thawing. Raytheon claims this timing to be 95 per-cent better than any existing stove. The trick is that the radar heater warms from the inside out, while with conventional units it's just the opposite. But tell the girl-friend not to get her hopes up—radaranges will be too costly for home use. Raytheon plans to make a hundred thousand of them in the next few years—for railroad diners, airliners, and vending machines.

BBC'S HYPNOTISM experiment via television was conducted privately, and officials were more shocked than pleased by its success. Peter Casson, a young ex-Royal Navy enlisted man, put some of the BBC brass so soundly asleep that he had to get off the air and talk to them personally before they woke up. One of them, more imaginative than the rest, began to think with horror of a whole nation being put to slumber by some future Hitler in the days when television will be as common (he said) as regular radio is now. The British immediately buried this possibility in England by barring hypnotists from television studios. Casson countered with the plea that telehypnotism could be used to help cure stammering and other neurotic disorders—he was successful with shell-shock cases during the war—but the BBC rule remains. U. S. televisors took an equally dim view. Said John F. Royal, National Broadcasting System vice-president in charge of television: "We feel hypnotism could be potentially a very dangerous and risky thing." No less ominous, perhaps, was his closing remark: "If people fall asleep watching our television," quoth he, "we trust it will be from natural causes."

THE BABY-SITTER DEVICE is the brain-child of a Washington, D. C., ex-electronics instructor, also a Navy man (U.S.). He is Keith C. Johnson, and has rigged equipment that broadcasts baby yells to and from his home and those of two neighbors, also with small children. The system amplifies baby sounds so that you can hear quiet breathing clearly in the receiver at the other end of the line. If the baby really tunes in with a howl, the loud-speaker nearly shakes the roof off. The trick is for the Johnsons to go to the movies, while one of the neighbors watches the kiddies by tuning in; another night, a neighbor goes to the movies, the Johnsons listen. Cost of the equipment, Mr. Johnson says, runs about $15 per family—$45 for his hook-up. In Washington, where baby-sitters are scarce, his device has created a sensation, but from where we sit (with an 18-month-old youngster upstairs) Johnson should be given dubious credit. Whoever heard of magnifying an infant yell—we can hear ours, when he gets going, for a mile upwind, without hook-up. We think that Mr. Johnson should be censured severely for aiding and abetting the situation.

THERE ARE a substantial number of good jobs in FM broadcasting, according to experts who recently attended the FM Association convention—first of its kind—in Washington. One of the delegates, Don Martin, of the School of Radio Arts in Hollywood, whose organization has been swamped with requests, estimates the grand total of openings to be more than 7000. This is on the basis that the average FM local station will have to have a manager, a sales manager, a production staff with a minimum of three announcers, a three-man technical staff, some kind of office manager, and a receptionist—ten persons in all. With (a conservative) 700 stations expected to be going by the end of 1947, he believes 7000 an equally conservative personnel figure. Speaking very generally—the talent of the individual, plus experience, and the city in which he works are important

The New DELCO RADIO Combination

For those who demand the Best

This handsomely styled, engineered-for-tomorrow radio-phonograph combination features the finest in AM and FM reception, with fourteen tubes plus rectifier, and a mammoth 15-inch speaker for full tone range. It provides push-button tuning—not only on the standard AM broadcast bands but on FM as well!

And the phonograph? Here again Delco offers the best of all that's new! A special lightweight tone arm, with sapphire permanent-point pick-up, gives amazing fidelity and tone quality . . . but that's not all! Its advanced design eliminates needle changing, makes records last years longer.

Add to these great features a smooth-action record changer with the extra capacity of fourteen 10-inch records or ten 12-inch records—an automatic shut-off that goes into action when the last record is played—and you realize that this instrument has *everything!*

To put this magnificent Delco combination in anything but the finest cabinet would be unthinkable. Expert craftsmen have produced cabinets of grace and distinction to give it the proper setting. Model R-1251 in walnut, and Model R-1252 in mahogany, are masterpieces of fine furniture.

Like other Delco portables and table models, this fine new Delco combination brings new honors to the trusted Delco name of General Motors. United Motors Service, General Motors Building, Detroit 2, Michigan.

Production is Improving

But there are still many shortages of materials and component parts which make it impossible to meet the large demand for Delco radios at this time. If your distributor is unable to fill your order for Delco radios promptly, keep trying. You can count on it that he's doing his best, and that we're doing ours to speed production.

UNITED SERVICE MOTORS

DELCO RADIO

A GENERAL MOTORS PRODUCT

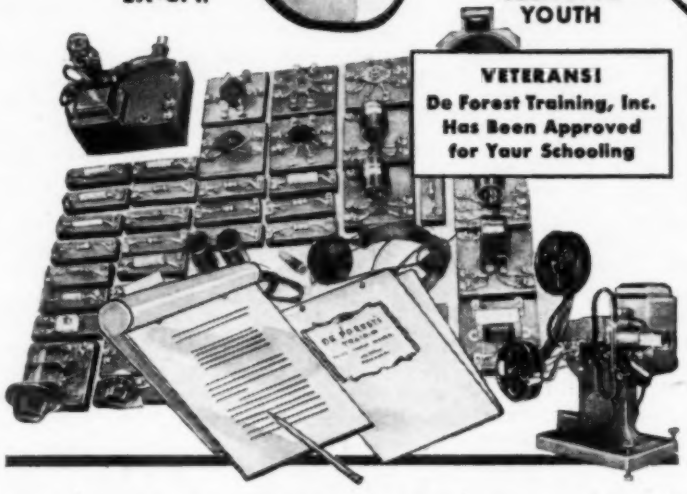
Delco radios are distributed nationally by United Motors Service. See your United Motors distributor about the Delco radio line.

SPOT RADIO NEWS factors—price tags on the jobs begin at $60 per week for announcers, $75 for a chief engineer, $60 for operators. Combination men — Mr. Martin is training announcer-operators, for instance—get proportionately more. Supply of trained personnel, he reports, is far behind demand and "the need stands to be a real problem." To get such jobs, if you are qualified, best bet according to the leaders with whom we talked is to contact your nearest FM station, especially if it has not yet started operations.

FM-ERS, INCIDENTALLY, are the most optimistic businessmen in the nation today. With fewer than average transition problems after the war—they had nothing to "transition" from—with a brand-new gadget that has proved already that it fills a real need, and with RMA campaigning for "A Radio for Every Room—A Radio for Every Purpose"—FM manufacturers and broadcasters go into the spring proclaiming that 1947 is their year. Typical of the industry attitude is the recent statement by Prof. E. H. Armstrong, FM's inventor, that the new-style radio business has a potential of $100,000,000 a year on sets alone —and will go up from there. "The evidence indicates manufacturers can sell FM sets as fast as they can be turned out," he added. A production of 5,000,000 FM sets in 1947 is predicted by W. R. David of the General Electric Company. Less than 150,000 were produced in 1946. David also predicts that nearly a thousand stations will be in operation before 1948 rolls round. He hails their coming as "the biggest thing that has ever happened in radio broadcasting, the FM transmitter business, or the FM receiver business." . . . Roy Hofheinz, KTHT-KOPY, Houston, Tex., new FMA president, joined the others in predicting a banner year.

THE RADIO - IN - EVERY - ROOM campaign being conducted by RMA will—in case you don't already know —play up FM. Edward R. Taylor of the Zenith Radio Corporation, Chicago, is in charge of the drive. He says FM will open a huge new field for sales efforts and is a compelling reason for increasing the number of radios in the home. The increased number of radio stations which FM is bringing on the air, he adds, makes it more imperative to have additional receivers so that every member of the family may get his favorite program, if necessary, at the same time. . . . He brings out a number of other interesting facts: About 90 per-cent of American homes now have at least one radio. One out of every three families has at least two. Most radio sets today are in the living room. Bedrooms run second, the kitchen a poor third. The great majority of radio receivers in the living room are consoles and radio-phonograph combinations, while the bedroom has the greatest number of midgets and table

Let Us Show You How to Prepare
TO MAKE REAL MONEY QUICKLY!!



Whether you are an ex-G. I., a teen-age youth, or an older man eager to earn real money...There can be a place for you in The Billion Dollar Field of Electronics and Radio

You will probably find no greater variety of money-making opportunities than in the fields of Electronics and Radio. Hundreds of men, who today either successfully operate their own businesses or hold important jobs in these fascinating fields, are graduates of DeFOREST'S TRAINING, INC.

Our Home Study or Residence courses, thorough in every detail, offer a unique combination of training advantages. We furnish you with a 16 millimeter Motion Picture Projector and 12 reels of valuable movie film. You also use 8 big kits of Radio- Electronic parts as shown on this page, enabling you to work out 133 MODERN EXPERIMENTS for valuable practical experience.

When you prepare to enter the exciting fields of Electronics and Radio, you will want every necessary home study benefit. DeFOREST'S TRAINING, INC. gets you off to a brighter future by supplying these major benefits at home; (1) Learn by Seeing from movies showing radio circuits in action as well as other clearly animated illustrations (2) Illustrated Loose-leaf lessons with handy fold-out diagrams help make our training easy to understand. (3) Learn By Doing . . . in your home laboratory you have the opportunity to get real "SHOP METHOD" experience from the many commercial type Radio-Electronic parts you receive. (4) Employment Service . . . after you complete your training, our effective employment service helps you GET STARTED.

DeFOREST'S TRAINING, INC. offers the only Home Study or Laboratory training in the nation endorsed by the New York Museum of Science and Industry, Radio City, New York City.

NATIONALLY KNOWN RADIO STATION CONSULTING ENGINEER RECOMMENDS COURSES OF DeFOREST'S TRAINING, INC.

"Now is the time . . . to prepare to enter the fields of Radio and Electronics . . . no greater opportunity is afforded the high school student . . . the war veteran . . . or the man who is eager to make more money," says Ellery L. Plotts, nationally known Radio Station Consulting Engineer and former Special Research Associate at Harvard University's Radio Research Laboratories. "A study of the DeForest Training, Inc. courses enables me to highly recommend either the Home Study or Residence course."

EX-G. I. STUDENT LAUDS DeFOREST'S EMPLOYMENT SERVICE

"Dear Sir: Due to the fact that I am enrolled in your school, I am now employed by the Westinghouse Manufacturing Company instead of a steel mill. This is a great opportunity for me because this is a new branch opening in this territory and there is a great chance for advancement.

Elmer H. Havens
Lancaster, New York"

DeFOREST'S
TRAINING, INC.
CHICAGO, ILLINOIS

Without obligation, send for our valuable, information-packed book, **"VICTORY FOR YOU."**
MAIL COUPON TODAY.

DeFOREST'S TRAINING, INC.
2533-41 N. Ashland Ave., Dept. RN-D3
Chicago 14, Illinois, U. S. A.

Send me your big book "VICTORY FOR YOU," showing how I may make my start in Radio-Electronics with your modern home training plan. No obligation.

Name.....Age.....

Address.....Apt.....

City.....Zone.....State....

☐ If under 16, check here for special information.

☐ If a discharged veteran of World War II, check here.

models. The kitchen runs second on midgets and third on table models. An estimated 20,000,000 pre-war radios are in need of replacement and Mr. Taylor expressed the opinion that many of them will be replaced by modern FM-AM receivers. . . . RMA is spending $50,000 on the drive, but thousands more will go into national advertising by industry members of the Association and cooperating sales groups.

LATEST DIRECT COMPARISON of FM-AM stations issued by FCC shows that this year began with 553 cities or metropolitan districts in the U. S. which had one or more licensed AM stations, but of these, no FM application has been received from 208, or 38 per-cent. Geography is the major factor in this—more than half of the non-applicants are located in the West Central, Mountain and Pacific regions. More specifically, the states in the West Central region in which proportionately few AM cities have provided FM applicants include North and South Dakota, Nebraska, Kansas, Arkansas and Oklahoma. These six states of the eleven in the region have a total of 57 AM stations, but FCC has received FM applications from only 19, or one out of three. Similarly, Montana, Wyoming, Colorado, New Mexico, Arizona, and Utah have 44 AM cities, but only 8 FM applicants—one out of five. Washington and Oregon, with 29 AM's and 9 FM applications, rate one out of three. . . . But the West is not alone in thin FM states—Maine, New Hampshire, Vermont, Alabama, and Mississippi show little enthusiasm for the new media, if applications are an indication. It follows that FM is most active in eastern metropolitan areas and in the middlewest.

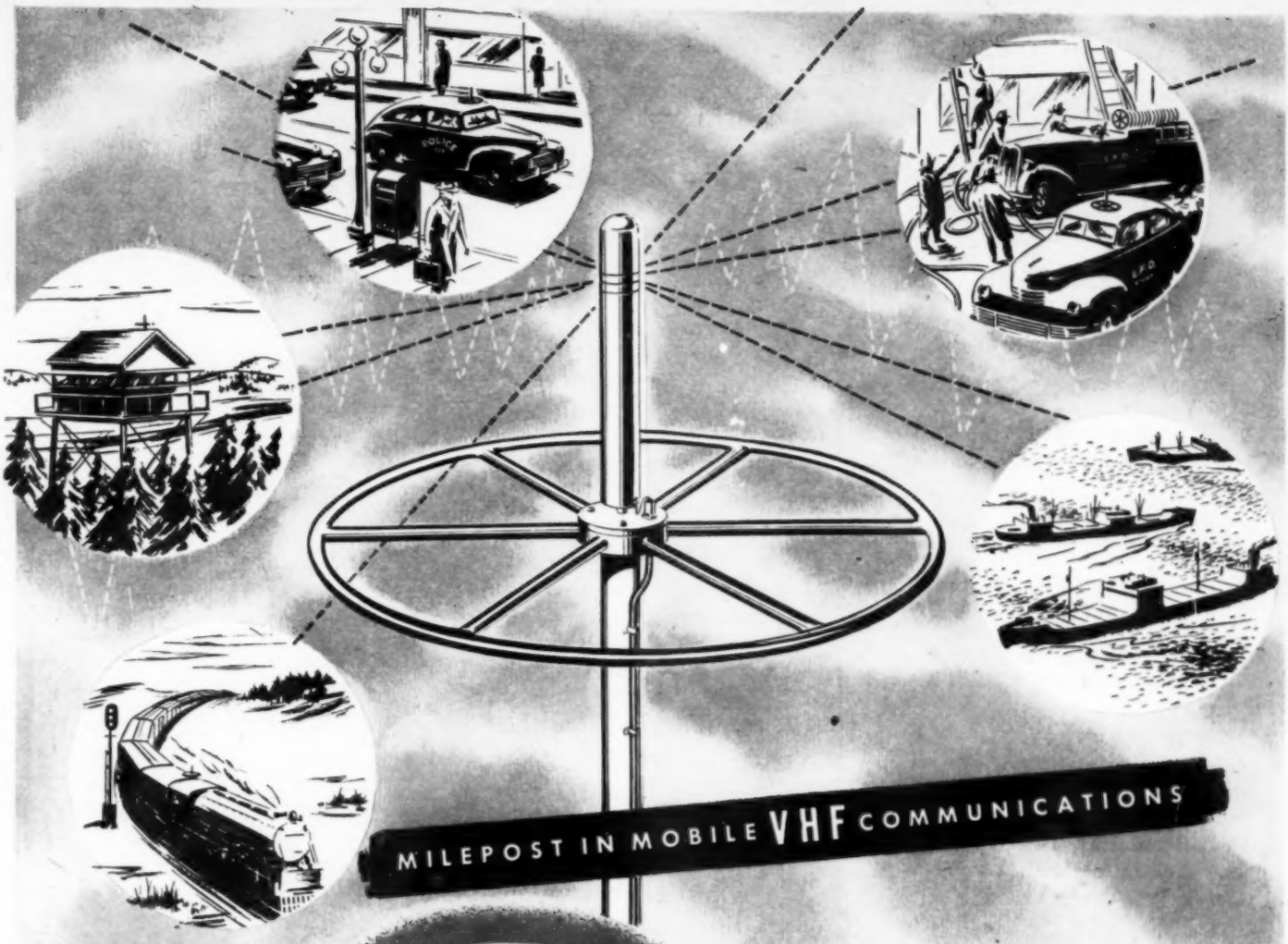
ALL OF WHICH is not to imply that AM broadcasting is not experiencing pretty good times itself, now that the war is over. Federal Communications Commission's most recent summary shows that a total of 365 permits for construction were granted for AM stations between VJ Day and last September 19. Of these, 187, or 51.2 per-cent, were issued in cities which had no existing radio station as of VJ Day. All such cities had populations of 50,000 or less. In addition, 82 construction permits, or 22.4 per-cent, were issued in cities with only one existing station and over half of these grants—57—went to cities of 50,000 or less. . . . The most common type of AM grant was for a 250 watt unlimited time station in a community of 50,000 or less. . . . More recent summaries are complete on FM activities. As of the first of this year, there were 136 stations on the air and construction permits granted since October 8, 1945, totalled 426. But AM still played an important role, even in the FM field. Of the permits issued, 74 per-cent were to persons already holding AM permits. An additional 12.6 per-cent were issued to non-AM newspaper interests. Over-all, 36.3 per-cent of the applicants had newspaper connections.

FCC, WHOSE PROFESSIONAL HAMS did dramatic work during the war detecting enemy radio activities, is having equally good luck catching up with domestic violators in the post-war world. The Commission's detection of illegal stations is so accurate, indeed, that those in charge of it keep wondering why anybody would want to try to beat the game. More than 200 illegal operators have been apprehended since the war ended. Many of them are kids up to mischief, and are dealt with accordingly on a first offense; but an increasing number of adults, who know exactly what they are doing and are under the illusion that they can get away with it, are showing up on FCC records. For these the going can be tough—maximum penalty may run to $10,000 or two years imprisonment—or both. . . . FCC does not take all the credit for its detection service, pointing out that 25,000 radio stations, 315,000 radio operators, and nearly 80,000 amateurs are always ready to report strange signals or an erratic "driver" in their bands. Hams "are especially quick to report," FCC says. Reports are relayed to FCC field offices and the Commission's 22 monitoring stations and from then on it's just a matter of time till the violator is run down. Why, in the face of this routine, illegal operators continue to crop up, is one of the minor mysteries at FCC headquarters in Washington these days.

ALTHOUGH, WHEN CONTRASTED with radio goings-on in this country, foreign activities seem small, they are nevertheless improving. In Japan, for instance, set production increased nine times its size between January and June of last year—from 8000 to 75,000. The Japs, like us, had tube trouble and total set production for the year was much less than we turn out in peak months. . . . Similarly, in England production for the year ending this spring was high for England—approximately 1,750,000 sets. Some 400,000 of these will be exported. The British Isles also report a new all-time high of radios in use—nearly 11,000,000. . . .

SUCH SAMPLINGS of the news from abroad indicate that U. S. manufacturers are far and away ahead of foreign competitors, and with this in mind the Radio Manufacturers Association has come out strongly through its export committee to urge the Federal government's support in protecting American interests. RMA's statement was made timely in light of the spring negotiations by the State Department on reciprocal trade agreements. RMA export committee chairman A. D. Keller has asked that trade barriers be withdrawn or reduced to "the point where our manufacturers

(*Continued on page* 153)



THE NEW AMPHENOL GROUND PLANE ANTENNA

Efficient VHF radio communications is a must in modern railroading. Used to expedite freight and express service, it is cutting hours from schedules, and eliminating waste time and money in switching operations.

Designed principally for use in the 152-162 mc band by railroads for "train-to-fixed-station" and "end-to-end" communications, the new Ground Plane Antenna illustrated is foremost among many new VHF radio components and accessories perfected by Amphenol engineers.

Providing maximum power radiation at low initial cost, this extremely rugged antenna consistently out-performs other antennas under normal and extreme conditions. It is easily and quickly installed, and has been thoroughly tested in main-line railroad installations.

Danger from lightning or contact with power lines is eliminated, as this antenna is at ground potential. The nature of its radiation pattern insures uninterrupted service during sharp "U" or "S" turns.

The Amphenol Ground Plane Antenna is also widely used by police and fire departments, by forestry, geophysical, power and petroleum field crews, for mobile marine installations, and many others. It is available with Ground Plane Skirt, as shown, for installations where a large metallic mounting surface is not available.

Write today for complete technical data on the Ground Plane Antenna, or for engineering aid in solving your VHF radio communications problems.

Depend upon AMPHENOL Quality

AMERICAN PHENOLIC CORPORATION
CHICAGO 50, ILLINOIS

COAXIAL CABLES AND CONNECTORS • INDUSTRIAL CONNECTORS, FITTINGS AND CONDUIT • ANTENNAS • RADIO COMPONENTS • PLASTICS FOR ELECTRONICS

Farnsworth RAILROAD RADIO

A MILESTONE IN RAILROAD RADIO!

"Modern railroad transportation systems cannot function to their maximum efficiencies without the use of modern communications networks. That is why the Santa Fe System maintains complete telephone and teletype, as well as telegraph systems along its entire thirteen-thousand-mile right-of-way. It is also the reason for Santa Fe's immediate and careful exploration of all new communications techniques, such as railroad radio, and accounts for the many 'firsts' contributed by the Santa Fe to the railroad communications art."

President
Atchison, Topeka and Santa Fe Railway

"RAILROADS . . . LIKE A GIANT CONVEYOR BELT"

"The war has emphasized the importance of American railroads. Like a giant conveyor belt, they link up the industrial, agricultural and mining areas of this country with the many thousands of markets that dot our land. With reconversion a fact, far-sighted railroad management is carefully exploring many technical war developments, and, in particular, radio, with the expectation that radio will help keep American railroads the safe, efficient and modern network of transportation which has so ably served the Nation during the war."

"THIS PIONEERING EFFORT . . ."

"The Chicago and North Western Railroad, always interested in technological developments which promise improvement in the efficiency and safety of railway operations, participated in the first regular use of very high frequency railway radio. This installation went into operation in our Proviso Yards in September, 1940, and continued for over a year thereafter.

"We are happy that the technical and operating information secured from the pioneering effort was subsequently useful to the Army Ordnance Department and to the operators of the large Army Ordnance Plants in making their decision to use railroad radio in connection with the war effort.

"The case histories provided by the use of radio at Proviso and in the large ordnance plants were later to become an important part of the railroad testimony in the Federal Communications Commission hearing which brought about the present allocation of frequencies for railway use."

PRESIDENT,
Chicago and North Western Railway System

Farnsworth radiotelephone systems, now ready to serve the Nation's railroads, provide:

(1) RELIABLE RADIOTELEPHONE CIRCUITS

Farnsworth guarantees its railroad radiotelephone systems for a period of one year—the same kind of comprehensive guarantee furnished with U. S. Government war-time radio equipment on which battles and lives depended.

(2) IMPROVED OPERATING SERVICES AND FACILITIES

Radiotelephone circuits between train crews and supervisory personnel permit industrial customer requirements to be fulfilled more rapidly; provide reliable and instantaneous communications even during adverse visibility conditions; enable the quick reporting of equipment failures and the more rapid and efficient dispatching of relief; permit crews instantly to report unscheduled stops to near-approaching trains.

(3) SAVINGS IN OPERATIONS

Railroads using modern radiotelephone circuits have reported through official Association of American Railroads documents convincing proof of the important money-saving, as well as safety-contributing abilities of radiotelephone circuits.

(4) LOW-COST INVESTMENT AND MAINTENANCE

Farnsworth equipment incorporates such important operating and maintenance features as standardized chassis with unitized construction, low-clearance antennas, automatically engaging plug-in type connectors, and special test circuits. The combination of these features, *found only in Farnsworth equipment,* guarantees maximum availability, flexibility, and usefulness with simplified low-cost maintenance. Yet, Farnsworth railroad radio equipment is priced competitively with other quality systems, many of which lack these special features.

For detailed particulars of Farnsworth Mobile Communications Systems, write Farnsworth Television & Radio Corporation, Dept. RN-3, Fort Wayne 1, Indiana.

"TO ATTAIN STILL HIGHER STANDARDS OF SERVICE . . ."

"An asset in which the Nickel Plate Road takes great pride is the high standard of service which it renders to the shipping public. With its record for outstanding performance during the war years back of it, the Nickel Plate is looking forward to the utilization of new technological developments, such as radio and teletype, in order to attain still higher standards of service and usefulness."

President,
The New York, Chicago & St. Louis R. R. Co.

"Train Radio to Aid in Operation of Pere Marquette's New Streamlined Trains"

"By virtue of their efficient and effective performance during the war, the nation's Railroads have won the respect and goodwill of the American people. It is essential that this public esteem be maintained. That is why progressive railroad managements are planning the use of many technical developments capable of making additional contributions to the safety and comfort of rail passenger service and why the new, streamlined passenger trains which Pere Marquette soon will put into operation are to be equipped with train radio communication systems."

President
Pere Marquette Railway Company

IS READY TO SERVE THE NATION

FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON 25, D. C.

ADDRESS ALL
TO THE

November 27, 1946

Mr. John Curtis, Manager
Mobile Communications Division
Farnsworth Television & Radio Corp.
Fort Wayne 1, Indiana

Dear Mr. Curtis:

I wish to thank you for your letter outlining the excellent progress which the Farnsworth Television and Radio Corporation has made in developing and producing various types of equipment for railroad radio communication. I was especially pleased to read that section of your report which quotes various railroad presidents who recognize that radio will enhance safety and efficiency in railway operations.

As you know, the Commission has been convinced for some time that a properly engineered railroad radio system will contribute to safety of life and property, both in preventing accidents and in reducing the seriousness of injury and damage after accidents. While safety is of paramount importance we also recognize and encourage the use of radio as a means of improving the overall efficiency of the railroads.

Sincerely yours,

E. K. Jett,
Commissioner

Commissioner Ewell K. Jett has been a motivating factor in the development of radio communications since the pioneering days of the early 20th Century. From 1911-1929 he participated in the development of the Navy's use of what was then a new communications art. Since 1929, Mr. Jett has been associated with the Federal Communications Commission and its predecessor, the Federal Radio Commission, first as Assistant Chief Engineer; then, since February 1, 1938, as Chief Engineer. On February 15, 1944, Mr. Jett was appointed Commissioner.

Throughout his career with the Navy and the Commission, Mr. Jett has been alert to the ever-increasing usefulness of radio in mobile operations. More recently, with the development of radio equipment for railway and highway services and Mr. Jett's origination of the Citizens' Radio Communication Service, his activities wth the Commission have taken on even more significance to American economy and well-being.

Farnsworth

Television · Radio · Phonograph-Radio

Farnsworth Radio and Television Receivers and Transmitters • Aircraft Radio Equipment • Farnsworth Television Tubes • Mobile Communications and Traffic Control Systems for Rail and Highway • The Farnsworth Phonograph-Radio • The Capehart • The Panamuse by Capehart

Now! A 2-Band, Table Model with Console Features — Standard and Short Wave Reception with Interference Eliminator

Here's the kind of price-quality feature which brings extra business into a fine radio shop. Air King precision craftsmanship enables you to present to your most appreciative customers a 2-Band, high performance radio finished in rich American walnut. The set has superb good looks and exceptional tone. When you see how brilliantly it demonstrates and remember that it offers fine radio reception on both standard and short wave, anywhere in the country, you can see its great possibilities as a stepper-up of immediate sales income.

Note this combination of Air King Features—

Interference eliminator that blocks out code telegraph. Built-in Phonograph Jack to accommodate automatic record changer. Convenient panel control for phonograph connection. 6 Tubes (including rectifier) with Superheterodyne circuit. 7 inch Selectorloop. Alnico #5 "Tone King" speaker.

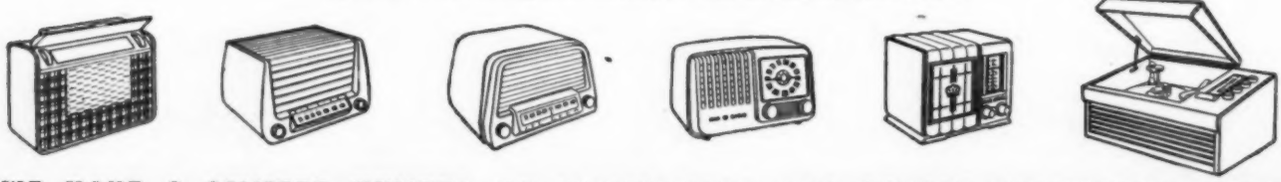
Air King Products Company, Inc.
1523-29 63rd Street, Brooklyn 19, N. Y.

The Royalty of Radio Since 1920

AIR KING
RADIO

Division of HYTRON RADIO & ELECTRONICS CORPORATION, *Brooklyn, N. Y.*

Export Address: Air King International, 75 West Street, New York 6, N. Y.



★ WE HAVE A LIMITED NUMBER OF DISTRIBUTOR AND DEALER TERRITORIES OPEN ★

Learn RADIO TELEVISION ELECTRONICS

I'LL TRAIN YOU AT HOME IN YOUR SPARE TIME

For a Good Pay Job or A BUSINESS OF YOUR OWN!

My Proven 2-Way Method Helps You Get into Radio *Quicker!*

Find out about the money-making opportunities Radio offers *you*. Learn how you can qualify for a good-pay job or start a business of your own *without capital*. Send below coupon for my big FREE book, "Your Opportunities in Radio & Television," which tells of radio's vast opportunities and how HOLLYWOOD RADIO & TELEVISION INSTITUTE has been training men for success in Radio for over 17 years, in over 40 different countries, through its proven 2-WAY METHOD—*LESSONS PLUS HOME SHOP PRACTICE!*

YOU PERFORM OVER 300 RADIO TESTS AND EXPERIMENTS

I send you 9 kits of radio parts with which you make hundreds of interesting, fascinating tests and experiments. You learn the "whys and hows" of radio *first hand, by doing*. Thus, you learn *more thoroughly, faster!*

MANY H.R.T.I. STUDENTS EARN MONEY IN SPARE TIME WHILE LEARNING

From the very start, through special "Spare Time Work Sheets," I show you how to earn money in spare time by doing good-pay radio jobs that abound in nearly every neighborhood. Many students earn $5, $10, and more a week while learning. A mighty good way to lay the foundation for a future radio business of *your own*.

Now is the time to start preparing for YOUR career in this fast-growing industry. Take the first step—send coupon for my big FREE Book today.

HERE'S PROOF OF THE QUALITY OF H.R.T.I. TRAINING

1st, 2nd and 4th Prizes Won by H. R. T. I. Students In Open Contest

With over 250 students and graduates from many Radio schools, as well as experienced radio men, competing to find the best Radio Technicians in Cuba . . . 7 out of the first 10 prizes were won by H.R.T.I. Graduates! These PROVEN RESULTS speak for themselves! You can't afford to gamble with your future. Choose the Radio School with the success record . . . H.R.T.I.

WHAT WINNER OF FIRST PRIZE SAYS:

"Your training methods are so practical, and so clear, that no one should have difficulty in learning. I found everything so easy that it makes me feel that anyone who takes your course can be sure of success."

LUIS ILLADA, *Havana, Cuba*

WHAT SECOND PRIZE WINNER SAYS:

"I am very happy about my success, but it is to you and the H.R.T.I. staff that I owe my success. I am deeply grateful to H.R.T.I. for I have received all and MORE than you promised when I enrolled."

ALFREDO RODRIGUEZ, *Oriente, Cuba*

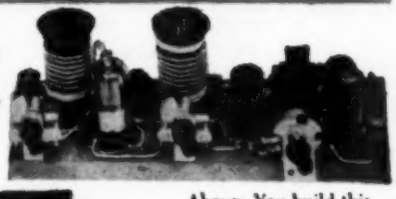
WHAT WINNER OF FOURTH PRIZE SAYS:

"The 1st, 2nd and 4th prizes were won by H.R.T.I. students! This shows that H.R.T.I. is one of the best schools! Over 250 radio technicians competed. Among them were real experts of established radio shops as well as students of nearly every known school. You will notice, from the enclosed newspaper, that the 4th prize was won by me, and I owe it all to your easy method of teaching."

GODFREDO REYES, *Oriente, Cuba*

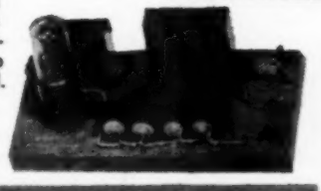
YOU GET 9 KITS OF RADIO PARTS WITH WHICH YOU PERFORM OVER 300 EXPERIMENTS

Left: You build this transformer coupled audio stage. (Experiment No. 260)



Above: You build this tuned radio stage, regenerative detector and audio amplifier. (Experiment No. 329)

Left You build this Multi-purpose Shop Test Panel. 5 Test instruments in one.



Left You build this A. C. Power Supply.

YOU LEARN BY DOING

You build these and many other radio circuits and testers with the 9 kits I send you, to help you learn faster, more thoroughly All kits become your property.

BIG FREE BOOK

HOLLYWOOD IS A WORLD CENTER

of radio broadcasting and manufacture—television—motion picture production. Thus, H.R.T.I. is in an excellent location to bring you modern, up-to-the-minute instruction.

Before you decide on *any* course you owe it to your future to find out about H.R.T.I. training. Read what graduates in 40 different countries say about this famous course. Just paste coupon on a postcard or send in envelope. No salesman will call.

HOLLYWOOD RADIO & TELEVISION INSTITUTE
810 West 6th Street, Los Angeles 14, California

C. H. Mansfield, President, Dept. E-1
Hollywood Radio & Television Institute
810 West 6th St., Los Angeles 14, Calif.

Send me your FREE book, "Your Opportunities in Radio, Television & Electronics" which explains your 2-way training method. (No salesman will call)

Name_____ **Age**____

Address_____

City_____ **Zone**____ **State**_____

DON'T PUT IT OFF, MAIL THIS COUPON AT ONCE!

BUY at NEWARK FOR REAL ECONOMY AND TOP QUALITY

Fresh Stock!

NEWARK CRYSTALS

6—11—20—40—80 METERS

Here's more of these precision cut, low drift crystals! Accurately calibrated, fully guaranteed.

80	Meter Type	X1— 3500- 4000	
40	" "	X2— 7000- 7300	
6	" "	X3— 6250- 6750	
11	" "	X4— 6797- 6866	KC
6	" "	X5— 8335- 9000	
20	" "	X6—14100-14300	

Send your order now. We will fill from stock to nearest specified frequency.

Sensational value at... 88¢

3 Asst. for only $2.40

in Stock!

GON-SET CONVERTERS

FOR 20, 10-11, OR 6 METERS

A necessary and reliable adjunct to your present receivers. For fixed and mobile use. Built-in pre-selection. Well-constructed, complete with connecting cables. Your cost—each, any type **$39.95**

Special Noise Silencer..... 8.25

DETROLA RECORD CHANGER

10" or 12" records. Free floating tone arm has high fidelity crystal pickup. Gearless, foolproof mechanism. Sensationally low price **$14.95**

Sturdy base, walnut finish, mounting holes and cutout provided. Your cost **$2.49**

TWO-CHANNEL CONTROL BOX

This 2 channel control box has wide and varied application in Ham shacks, P.A. and intercom work. Incorporates 4P. DT gang switches, 3 terminal plugs, several ¼-watt resistors and illuminated dial light including bulb, three 5 ft. cables and plugs. Brand new — a terrific buy!

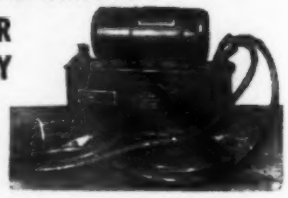
49¢

Build Your Own Record Player

A sturdy rim drive phonomotor — 78 r.p.m. Lightweight, high fidelity crystal pickup. Combination motor and turntable and pickup sell regularly for $15. Now you can own both, less cabinet, for only

$5.95

NEW DYNAMOTOR POWER SUPPLY



A fortunate buy enables us to offer a sensational new low price. All brand new. Operates from 6-12 Volt battery. Delivers 500 V DC at 160 ma. Special, your cost **$9.95**

DON'T MISS THIS!

Dynamic type earphone and microphone assembly that's a wonder of convenience, efficiency and compactness. 50 ohm impedance. 37" cord and plug. A TOP SPECIAL ... **$2.95**

Best Buy of the Year!

1 MIL METER

3½ in. R. D. CASE

A sensational value, this meter has higher sensitivity than a comparable movement selling for many times this price.

Basic movement is 0-1 mil and has a resistance of only 75 Ohms, with special construction to provide excellent damping. Scale reads 0-2 MA, 0-40 MA—has internal multiplier of 100r.

Only 600 available at this extremely low price—Order now. **$3.95 Ea.**

WESTINGHOUSE 3½" AC VOLTMETER

RECTIFIER TYPE

A rectifier type AC Voltmeter having sensitivity of 2,000 ohms per Volt. Basic movement 0-500 Micro Amps with enclosed rectifier. Scale reading 0-2 Volt. Round 3½" Bakelite Case. Meter made to sell for $17.00. Now at Newark for only ... **$3.95**

0-500 MICROAMMETER

Just received an additional shipment of these outstanding 2½" meters having a 0-500 MA movement, well damped, and with a 0-600 V. D.C. scale.

A swell meter for your rig or to have around the bench as a spare.

Don't fail to get yours at this especially low price **$2.95**

Standard Receivers Now Available!

HALLICRAFTERS	
S-3 complete	$47.50
S-40A complete	89.50
SX-42	275.00
NATIONAL	
HRO-5Tal complete	306.71
NC-240D with speaker	241.44
NC-46 with speaker	107.40
1-10A with tubes, less speaker and power supply	67.50
HAMMARLUND	
HQ-129X complete	173.25
SP-400X complete	342.00
RME-45 complete	198.70
RME-84 complete	98.70
Panadaptor	99.75
Temco 75 GA XMTR	495.00
Meck Transmitters	150.00

Mail orders filled promptly FOB New York or Chicago. Send 20% deposit with order. Prices subject to change.

T-17B MICROPHONE

Sturdy, high quality, lightweight 200 ohm single button carbon mike with press to talk button for transmitters, P.A., etc. Built in filter. **$1.49**

NEWARK'S SPECIAL FILTER CONDENSERS

Oil Filled—Oil Impregnated—Fully Guaranteed At Rated Voltages

Acclaimed by hams everywhere, these Newark condensers have been preferred favorites with amateurs for over ten years. Top quality at ridiculously low cost. Newark value at its best.

Cap. Mfd.	Working Voltage	Height	Width	Depth	Weight	Price
.15	4000 D.C.	2⅞	1¾	1	8 oz.	$.89
1	1000 D.C.	2⅛	1¾	1	12 oz.	.49
1	1200 D.C.	3¾	1¾	1	8 oz.	.49
2	1000 D.C.	3¾	1¾	1	12 oz.	.89
2.5	1500 D.C.	4¾	1¾	1	8 oz.	.99
4	1500 D.C.	4¾	1¾	Rd.Can	1¼ lbs.	1.99
4	3000 D.C.	4½	3⅛	1⅛	2½ lbs.	3.75
6	3000 D.C.	3¾	1¾	3 5/16	2⅛ lbs.	3.95
6	3000 D.C.	6	3¼	2¼	6 lbs.	3.25
8	2000 D.C.	5	5	3¼	2½ lbs.	2.75
8	3000 D.C.	4½	3¾	2½	7¼ lbs.	3.95
10	3000 D.C.	7⅞	6½	3⅜	3½ lbs.	4.75
13	1000 D.C.	4⅞	3¾	3¼	1¾ lbs.	2.25
15	3000 D.C.	3½	3¾	1¾	5 lbs.	5.25
*2 4	600 D.C.	4⅞	2½	1¼	14 oz.	.80
*2 6	800 D.C.					
*5 5	1000 D.C.	4½	2¾	2¼	2 lbs.	1.25
*5 15	1000 D.C.	3½	4⅝	3¾	4¼ lbs.	1.75

*IN ONE CAN.

● MAIL ORDERS FILLED FROM EITHER NEW YORK OR CHICAGO

● Write: 242-G W. 55th St., N. Y. C. or 323-G W. Madison St., Chicago

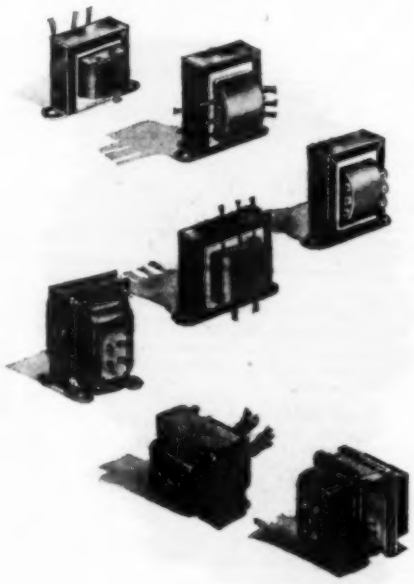
NEW YORK Offices & Warehouse 242 W. 55th St., N.Y.19

NEWARK ELECTRIC COMPANY, INC.

CHICAGO 323 W. Madison St. Chicago 6, Ill.

New York City Stores: 115-17 W. 45th St. & 212 Fulton St.

where you see the name STANCOR you can count on QUALITY



STANCOR stands for the highest standard of transformer performance . . . Wherever you see the black-and-yellow STANCOR merchandise display, you know you can rely on the product and the distributor who stands behind it. Yes, STANCOR stands foremost with radio service men . . . for the most complete selection of Replacement and General Purpose Transformers . . . and for advanced designs and universal application . . . Now, STANCOR adds new streamlined plant facilities to serve you better and faster . . . to help you make your service business bigger and more profitable.

standardize on STANCOR TRANSFORMERS

STANDARD TRANSFORMER CORPORATION • CHICAGO, ILL.

SUPERIOR IS AT YOUR SERVICE-

with a COMPLETE LINE of TEST INSTRUMENTS

IMMEDIATE SHIPMENT Please place your order with your regular radio parts jobber. If your jobber does not handle our line kindly write for a list of jobbers in your state who do distribute our instruments or send your order directly to us.

Now you can SEE and HEAR

The signal with the new CA-12 SIGNAL TRACER

Always ready for instant use it takes less than five seconds to begin using this versatile unit. No maze of special cables—the Model CA-12 uses only one connecting cable. No line cord—the CA-12 operates on self-contained batteries. No tuning controls of any kind are used in this model.

FEATURES:

- *Comparative intensity* of the signal is read directly on the meter—*Quality* of the signal is heard in the speaker.
- Simple to operate—only one connecting cable—no tuning controls.
- Highly sensitive—uses an improved vacuum-tube voltmeter circuit.
- Tube and resistor capacity network are built into the detector probe.
- Built-in high gain amplifier—Alnico V. speaker.
- Completely portable—weight 8 pounds—measures 5½"x6½"x9".

The Model CA-12 comes complete with Detector Probe, test leads, self-contained batteries and instructions. Comes housed in heavy gauge crystalline cabinet with beautiful two tone etched front panel. **NET PRICE**..... **$34.85**

The New Model 670 SUPER METER

A Combination VOLT-OHM MILLIAMMETER plus CAPACITY REACTANCE, INDUCTANCE and DECIBEL MEASUREMENTS.

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts.

A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts.

OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts.

D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes.
RESISTANCE: 0 to 500/100,000 ohms 0 to 10 Megohms.
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (quality test for electrolytics)
REACTANCE: 700 to 27,000 Ohms 13,000 Ohms to 3 Megohms.
INDUCTANCE: 1.75 to 70 Henries, 35 to 8,000 Henries.
DECIBELS: —10 to +18, +10 to +38, +30 to +58.

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½"x7½"x3"..... **NET $28.40**

The New Model 650 SIGNAL GENERATOR

Ranges: 100 Kilocycles to 35 Megacycles on Fundamentals; 25 Megacycles to 105 Megacycles on Harmonics.

- RF obtainable separately or modulated by the Audio Frequency.
- Audio Modulating Frequency—400 cycles pure sine wave—less than 2% distortion.
- Attenuation—3-step ladder type of attenuator (T pad).
- Uses a Hartley Excited Oscillator with a Buffer Amplifier.
- Tubes: 6J5 as R.F. Oscillator; 6SA7 as modulated Buffer and Mixer; 6SL7 as audio oscillator and rectifier.

Complete with coaxial cable, leads and instructions..... **$48.75**

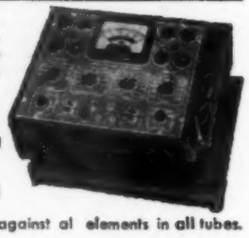
The New Model 450 TUBE TESTER

Speedy operation—assured by newly designed rotary selector switch which replaces the usual snap, toggle, or lever action switches.

- Tests all tubes up to 117 volts.
- Tests shorts and leakages up to 3 Megohms in all tubes.
- Tests both plates in rectifiers.
- New type line voltage adjuster.
- Tests individual sections such as diodes, triodes, pentodes, etc. in multi-purpose tubes.
- Noise-Test—detects microphonic tubes or noise due to faulty elements and loose internal connections.
- Uses a 4½" square rugged meter.
- Works on 90 to 125 volts 60 cycles A.C.

EXTRA SERVICE—May be used as an extremely sensitive condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute..... **$39.50**

The New Model 600 SET TESTER



A NEW COMBINATION TUBE TESTER AND MULTIMETER. A complete testing laboratory all in one unit. Test tubes. Reads A.C. Volts, D.C. Volts, D.C. Currents, Resistances and Decibels.

TUBE TESTER SPECIFICATIONS:

- Speedy operation—assured by newly designed rotary selector switch.
- Tests all tubes up to 117 Volts.
- Tests shorts and leakages up to 3 Megohms in all tubes.
- Tests leakages and shorts of any one element against all elements in all tubes.
- Tests both plates in rectifiers.
- Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
- New type line voltage adjuster.

MULTI-METER SPECIFICATIONS:

D.C. VOLTS: (At 1,000 Ohms Per Volt) 0 to 7.5/15/75/150/750/1,500 Volts.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts.
D.C. CURRENT: 0 to 1.5/15/150 Ma., 0 to 1.5 Amperes.
RESISTANCE: 0 to 2,000/20,000/200,000 Ohms, 0 to 20 Megohms.
DECIBELS: (Based on zero decibels equals .006 Watts into a 500-Ohm line.) —10 to +18 D.B., +10 to +38 D.B., +30 to +58 D.B. **$62.50**

The New Model 400 ELECTRONIC MULTI-METER

A combination vacuum-tube voltmeter and volt-ohm milliammeter plus capacity, inductance, reactance, and decibel measurements.

SPECIFICATIONS:

D.C. V.T.V.M. VOLTS: (At 11 Megohms Input Resistance.) 0 to 3/15/30/75/150/300/750/1500/3000 Volts.
D.C. VOLTS: (At 1,000 Ohms Per Volt.) 0 to 3/15/30/75/150/300/750/1500/3000 Volts.
A.C. VOLTS: (At 1,000 Ohms Per Volt.) 0 to 3/15/30/75/150/300/750/1500/3000 Volts.
D.C. CURRENT: 0 to 3/15/30/75/150/300/750 Ma., 0 to 3/15 Amperes.
RESISTANCE: 0 to 1,000/10,000/100,000 Ohms; 0 to 1/10/1,000 Megohms.
CAPACITY: (In MFD.) .0005—.2, .05—20, .5—200.
REACTANCE: 10 to 5M (Ohms), 100—50M (Ohms), .01—5 (Megohms).
INDUCTANCE: (In Henries.) .035-14, .35-140, 35-14,000.
DECIBELS: —10 to +18, +10 to +38, +30 to +58. **NET** **$52.50**

SUPERIOR INSTRUMENTS CO.

Dept. RN 227 FULTON ST., NEW YORK 7, N.Y.

Here they are

THE WORLD'S OUTSTANDING RADIO and ELECTRONIC BOOKS

THE OUTSTANDING PRACTICAL HANDBOOK

The "RADIO" HANDBOOK

ENLARGED TENTH EDITION

Radio's outstanding practical text. How-to-build-it descriptions of dozens of tested-and-tried types of transmitting, receiving and test equipment. Supplemented by basic electrical and radio theory in the simplest possible language for those without mathematical or technical training.

Illustrated with hundreds of diagrams and large photographs showing details of construction. Has the most complete tube tables to be found in any book.

New edition contains expanded U.H.F. sections, more test equipment which can be home-built, enlarged and modernized receiving and transmitting tubes tables, grounded-grid amplifier data, speech clipping, splatter suppressor, cathode follower data, pulse-time modulation, transformerless power supplies, wave guides, cavity resonators, butterfly circuit, klystron, U.H.F. crystal diode, radar and highly-efficient mobile antennas.

The ideal text for the practical radioman.

Over 700 pages, durably clothbound, gold-stamped Book RH, $2.50 at your dealers. Postpaid, $2.75 in USA.; elsewhere, $3.00.

The WORLD'S RADIO TUBES

U. S., British, French, Czech, German, Italian, Russian, etc., etc.

240 pages of complete characteristics with explanations up to date 1946 edition just out

ELECTRONICS says, "Here at last is the radio tube handbook radio engineers have dreamed of . . . in seven carefully prepared tables and charts."

"Probably the most complete and authoritative set of tube-data in existence," says RADIO CRAFT.

BUY IT AT YOUR FAVORITE RADIO PARTS DEALER or direct by mail from us.

$2.50 per copy; add 15c postage outside U.S.A.

RADIO ENGINEERING HANDBOOKS

RADIO ENGINEER'S HANDBOOK by F. E. Terman

The wealth of technical data contained in this handbook makes it indispensable as a complete reference work on radio and electronics. Charts, tables, circuit diagrams, and concise text material simplify the solution of complex, as well as simple problems.

Tables, Mathematical Relations, and Units. Circuit Elements. Circuit Theory. Vacuum Tubes and Electronics. Vacuum-Tube Amplifiers. Oscillators. Modulation and Demodulation. Power Supply Systems. Radio Transmitters and Receivers. Propagation of Radio Waves. Antennas. Radio Aids to Navigation. Measurements.

Book No. TH10 — 1019 pages — $7.00*

RADIO ENGINEERING HANDBOOK by Henney and Others

An extensive reference book prepared by 28 specialists. Contains abundant explanatory material, diagrams, formulas, and tables in each branch of the radio field.

Mathematical and electrical tables. Electric and Magnetic Circuits. Resistance. Inductance. Capacitance. Combined L, C and R Circuits. Measurements. Vacuum Tubes. Oscillators. Modulators. Detection. A.F. and R.F. Amplifiers. Receiving Systems. Power Supplies. High Frequencies. Code Transmission and Reception. Aircraft Radio. Antennas. Television. Facsimile. Broadcasting. Loud speakers and Acoustics.

Book No. HH10 — 945 pages — $6.00*

THEORY

FUNDAMENTALS OF RADIO by F. E. Terman

A first book and also a good refresher for all radio students and workers. This text has been widely used in civilian and military classes. Requires no knowledge of complex mathematics.

Contents: The Fundamental Components of a Radio System. Circuit Elements. Resonant Circuits and Circuit Analysis. Fundamental Properties of Vacuum Tubes. Vacuum-tube Amplifiers. Power Amplifiers. Vacuum-tube Oscillators. Modulation. Vacuum-tube Detectors. Sources of Power for Operating Vacuum Tubes. Radio Transmitters. Radio Receivers. Propagation of Radio Waves—Antennas. Radio Aids to Navigation. Television. Acoustics.

Book No. TF10 — 458 pages — $4.00*

PRINCIPLES OF RADIO by Keith Henney

A basic course in radio which may readily be comprehended by high-school or trade-school students and may be used in independent home study. Well illustrated.

Contents: Fundamentals. Direct-Current Circuits. Electrical Meters and Measurements. Production of Current. Magnetism and Electromagnetism. Inductance. Capacitance. Properties of Alternating-Current Circuits. Resonance. Properties of Coils and Condensers. Vacuum Tubes. The Tube as an Amplifier. Rectifiers and Power Supply Apparatus. Audio Amplifiers. Detection. Receiver Sysytems. Oscillators. Transmitters. Antennas and Electromagnetic Radiation. Frequency Modulation. Ultra-High Frequency Phenomena. Electronic Instruments.

Book No. HP20 — 534 pages — $3.75*

THEORY (Contd.)

RADIO ENGINEERING by F. E. Terman

Probably the most popular foundation engineering textbook for all serious radio courses and libraries. Thoroughly revised.

The Elements of a System of Radio Communication. Circuit Constants. Properties of Resonant Circuits. Fundamental Properties of Vacuum Tubes. Vacuum-tube Amplifiers. Power Amplifiers. Vacuum-tube Oscillators. Modulation. Vacuum-tube Detectors. Sources of Power for Operating Vacuum Tubes. Radio Transmitters. Radio Receivers. Propagation of Waves. Antennas. Radio Aids to Navigation. Television. Sound and Sound Equipment.

Book No. TE10 — 813 pages — $6.00*

BASIC ELECTRICITY FOR COMMUNICATIONS by W. H. Timbie

A student wishing a sound grounding in electrical fundamentals before undertaking the study of communications, and the communications student or worker requiring a reference book or refresher course in electricity will find Timbie admirably suited to the need. The few mathematical applications, which never go beyond simple algebra, are completely explained in this book. A summary follows each chapter, and well chosen problems are offered to test the student's learning and to give practice in applying electrical principles.

Book No. TB20 — 603 pages — $3.75*

ELECTRONICS FOR ENGINEERS by John Markus and Vincent Zeluff

This unique book condenses much invaluable electronic engineering data into graphs, charts, tables, and concise articles. In this way, it short-cuts the looking up of information. The tool value of this book is tremendous.

Book No. ME11 — 390 pages — $6.00*

ELECTRON TUBES

ELECTRONICS IN INDUSTRY by G. M. Chute

A non-technical treatment of the subject for the Industrial technician or executive. Electron-tube applications in numerous industries are described. Concise, meaty explanations are augmented by well-chosen diagrams.

Book No. CE10 — 403 pages — $5.00*

THEORY AND APPLICATION OF ELECTRON TUBES by H. J. Reich

The fundamentals of electron tubes and tube circuits. This well-known text has been revised and includes such modern topics as pulse generation. An excellent book for the communications man who wants to be well informed on tubes.

Book No. RT10 — 670 pages — $5.50*

ELECTRON TUBES IN INDUSTRY by Keith Henney

This book, rich in industrial applications and explanatory theory, was written expressly for the industrial engineer and technician. It reviews electrical, tube, and circuit theory and describes numerous electronic devices which have been tried and proven in various electrical and non-electrical industries.

Book No. HT10 — 539 pages — $5.50*

* Add 3% (minimum, 10c) for postage and packing; foreign, 10%. Prices are subject to change without notice.

If you don't live near or deal regularly with one of the above dealers, order direct from us.

Editors and Engineers LTD. 1302 KENWOOD ROAD Santa Barbara CALIFORNIA

These Dealers Also Regularly Stock Most of the Following Books and Can Obtain Rapidly Most Items Not In Stock

Elementary Theory

"Fundamentals of Radio," Terman	$4.00*
"Principles of Radio," Henney	3.75*
"Basic Elec. for Communications," Timbie	3.75*
"Electronics," Coyne	4.95*
"Radio Physics Course," Ghirardi	5.00*
"Elements of Radio," Marcus	4.00*
"Fundamentals of Radio," Everitt	5.00*
"New Radioman's Guide," Audel	4.00*
"Understanding Radio," Watson	2.80*
"Electrical Communication," Albert	5.50*
"Elec. Fund of Communications," Albert	4.00*
"Basic Radio," Hoag	3.50*
"Short Wave Wireless Comm.," Ladner	6.50*
"Electrical Essentials of Radio," Slurzberg	4.50*
"Foundations of Radio," Duncan	2.75*
"Radio: Fundamental Prin. & Prac.," Almstead	1.80*
"Basic Radio Principles," Suffern	3.50*
"Radio Material Guide," Almstead	2.20*

Intermed. & Advanced Theory & Engineering

"Radio Engineering," Terman	$6.00*
"Fund. of Engineering Electronics," Dow	5.50*
"Prin. of Radio Communication," Morecroft	8.50*
"Engineering Electronics," Fink	4.00*
"Applied Electronics," M. I. T.	6.50*
"Communication Engineering," Everett	5.50*
"Electronics," Millman	5.50*
"Electronics for Engineers," Markus	6.00*
"Fund. of Electric Waves," Skilling	3.00*
"High-Freq. Alternating Currents," McIlwain	6.50*
"Radio Receiver Design," Sturley	5.00*
"The Technique of Radio Design," Zepler	4.00*
"Prin. of Radio Engineering," Glasgow	4.50*
"Communication Networks Vol. 1," Guillemin	5.50*
"Communication Networks Col. 2," Guillemin	8.00*

Electron Tubes & Industrial Electronics

"Electron Tubes in Industry," Henney	$5.50*
"Industrial Electronic Control," Cockrell	2.75*
"Electronics in Industry," Chute	5.00*
"Theory & Appl. of Electron Tubes," Reich	5.50*
"Prin. of Electron Tubes," Reich	4.00*
"Inside the Vacuum Tube," Rider	4.50*
"Fund. of Vacuum Tubes," Eastman	5.00*
"Principles of Electronics," Kloeffler	2.75*
"The Physics of Electron Tubes," Koller	3.25*
"High-Freq. Thermionic Tubes," Harvey	3.50*
"Theory of Thermionic Vac. Tubes," Chaffee	6.50*
"Electronic Devices," Audel	2.00*
"Experimental Electronics," Muller	4.65*
"Electromagnetic Waves," Schelkunoff	7.50*
"Electromagnetic Theory," Stratton	6.50*
"Electric Circuits," M. I. T. Staff	7.50*
"Photocells & Their Applications," Zworykin	3.50*
"Graphical Const. for Vac. Tube Circuits"	3.00*
"Electron Optics & the Electron Microscope"	10.00*
"Theory of Gaseous Conduction & Electronics"	5.00*
"Electronic Control in Resistance Welding"	4.50*

Radio Mathematics

"Math. for Electricians & Radiomen," Cooke	$4.50*
"Applied Math. for Radio & Comm. Eng'rs," Smith	3.50*
"Math. of Radio Communication," Wang	3.30*
"Math. & Calculation for Mechanics," Audel	2.00*
"Math. for Radio and Comm. Book 1," Maedel	3.75*
"Math. for Radio and Comm. Book 2," Maedel	4.00*
"Mathematics for Electricians," Kuehn	1.80*

Utra-High Frequencies

"U.H.F. Radio Simplified," Kiver	$3.25*
"Introduction to Microwaves," Ramo	3.00*
"Communication Circuits," Ware	2.75*
"U.H.F. Techniques," Brainerd & 4 authors	5.00*
"Hyper & U.H.F. Engineering," Sarbacher	6.00*
"Understanding Microwaves," Young	6.00*
"Ultra High Frequency Radio Engineering," Emery	3.60*
"Field & Waves in Modern Radio," Ramo	5.50*
"Trans. Lines, Antennas & Wave Guides," King	3.50*
"Microwave Transmission," Slater	4.00*
"Electromagnetic Engineering," King	6.00*
"Phenomena in High Freq. Systems," Hund.	6.50*

Operating Practice—Commercial & Aero.

"Practical Radio Communication," Nilson	$6.50*
"The Radio Manual," Sterling	6.50*
"Radio Operating Ques. & Answers," Nilson	3.50*
"How to Pass Radio License Exams.," Drew	1.25*
"Radio Code Manual," Nilson	2.75*
"Radio Direction Finders," Bond	3.50*
"Prin. of Aeronautical Radio Eng'ring," Sandretto	4.00*
"Aircraft Radio & Elec. Equipment," Morgan	4.50*
"Aeronautic Radio," Eddy	4.50*
"Radio Navigation for Pilots," McIntosh	2.75*

Radio Servicing

"Modern Radio Servicing," Ghirardi	$5.00*
"Prin. & Prac. of Radio Servicing," Hicks	4.00*
"Radio Service Trade Kinks," Simon	4.50*
"Radio Troubleshooter's Handbook," Ghirardi	5.00*
"Electrical and Radio Troubleshooting Manual," Coyne	8.00*
"Cathode Ray Patterns," Bly	1.75*

Books by John F. Rider:

"Automatic Record Changers & Recorders"	$9.00*
"Vacuum Tube Voltmeters"	2.50*
"Servicing by Signal Tracing"	4.00*
"Frequency Modulation"	2.00*
"The Meter at Work"	2.00*
"The Oscillator at Work"	2.50*
"The Cathode Ray Tube at Work"	4.00*
"Inside the Vacuum Tube"	4.50*
"Servicing Superheterodynes"	2.00*
"Automatic Frequency Control Systems"	1.75*
"Servicing Receivers by Resistance Measurement"	2.00*
"D.C. Voltage Distribution in Radio Receivers"	1.25*
"Alternating Currents in Radio Receivers"	1.25*
"Resonance & Alignment"	1.25*
"Automatic Volume Control"	1.25*

F. M., Television and Radar

"Principles of Radar, M. I. T.	$5.00*
"Prin. of Television Engineering," Fink	5.50*
"Television Standards and Practice," Fink	5.50*
"Television Simplified," Kiver	4.75*
"Television," Zworykin	7.00*
"Frequency Modulation," Hund	4.50*
"Radar—What It Is," Rider	1.00*
"Electron Optics in Television," Maloff	4.00*

Handbooks and Reference Data

"The Radio Handbook	$2.50*
"Radio Engineering Handbook," Henney	6.00*
"Radio Engineer's Handbook," Terman	7.00*
"The World's Radio Tubes," Brans	2.50*
"Standard Handbook for Elec. Engrs., Knowlton	9.00*
"Electrical Engineers' Handbook," Pender	6.00*
"Radiotron Designer's Handbook"	1.00*
"Reference Data for Radio Engineers"	2.00*
"American Electrician's Handbook," Croft	5.00*
"Electricians' Handbook," Coyne	2.75*
"The Inductance Authority," Shiepe	2.50*
"Electronics Dictionary," Cooke	5.00*
"Electrical Dictionary," Coyne	1.00*

Miscellaneous

"Piezoelectricity," Cady	$9.00*
"Measurements in Radio Eng'ring," Terman	4.50*
"High Frequency Measurements," Hund	5.50*
"Radio-Frequency Elec. Measurements," Brown	4.50*
"Radio Frequency Measurements," Hartshorn	4.75*
"Drafting for Electronics," Carini	2.50*
"Radio-Freq. Meas. by Bridge & Res. Method"	4.75*
"Gaseous Conductors," Cobine	6.00*
"Electronics Laboratory Manual," Wright	1.00*
"Lab. Manual on Radio. Fund. Prin. & Prac."	1.00*
"Fund. Radio Experiments," Higgy	1.75*
"Pulsed Linear Networks," Frank	3.00*
"Electrons in Action," Stokley	3.00*
"Primer of Electronics," Caverly	2.25*
"Electronics Today & Tomorrow," Mills	3.25*

Buy books

on radio from these leading radio parts dealers

WHO REGULARLY STOCK MOST OF THESE BOOKS, AND CAN OBTAIN QUICKLY NEARLY ALL OTHERS CURRENTLY IN PRINT

ALABAMA: Birmingham, Forbes Distributing, Reid Distributing.

ALASKA: Anchorage, Robbie's Radio Supply. Fairbanks, Fairbanks Radio Supply. Juneau, Alaska Electronics.

ARIZONA: Phoenix, Radio Parts, Radio Specialties.

ARKANSAS: Little Rock, Tanner Radio & Electronics.

CALIFORNIA: Fresno, Martin Distributing. Long Beach, Scott Radio Supply. Los Angeles, Radio Equipment Distributors, Radio Specialties. Oakland, Electric Supply. San Francisco, Offenbach-Reimus, Zack Radio. Santa Ana, Radio & Television Equipment. Santa Barbara, Channel Radio Supply.

COLORADO: Denver, Radio Products Sales, Western Electronic Lab. Co.

CONNECTICUT: Hartford, R. G. Scell & Co. New Haven, Congress Radio.

D. C., Washington: Capitol Radio Wholesalers, Kenyon Radio Supply, Sun Radio Service.

FLORIDA: Miami, Electronic Supply, Walder Radio. Pensacola, Grice Radio, Gulf Radio, Pensacola Appliance. St. Petersburg, Cooper Radio, Welch Radio Supply.

GEORGIA: Atlanta, Concord Radio, Southeastern Radio Parts.

IDAHO: Boise, Craddock's Radio Supply.

ILLINOIS: Chicago, Allied Radio, Concord Radio, Newark Electric. Peoria, Klaus Radio & Electric. Rock Island, Tri-City Radio Supply.

KANSAS: Topeka, Overton Electric Co.

KENTUCKY: Lexington, Radio Equipment. Owensboro, Central Electronic.

MARYLAND: Baltimore, Kann-Ellert Electronics, Wholesale Radio Parts.

MASSACHUSETTS: Boston, DeMambro Radio Supply, Radio Shack.

MICHIGAN: Detroit, M. N. Duffy & Co., Radio Electronic Supply. Muskegon, Industrial Electric Supply. Pontiac, Electronic Supply.

MINNESOTA: Duluth, Lew Bonn Co., Minneapolis, Lew Bonn Co., Northwest Radio Electric Supply.

MISSISSIPPI: Jackson, Cabell Electric.

MISSOURI: Joplin, 4-State Radio & Supply. St. Louis, Radonics.

NEBRASKA: Omaha, Omaha Appliance.

NEW JERSEY: Trenton, Allen & Hurley.

NEW YORK: Albany, Fort Orange Radio Distributing, E. E. Taylor Co. Buffalo, Genessee Radio & Parts, Radio Equipment. Jamaica, Norman Radio Distributors. Middletown, L. & S. Radio Sales. Niagara Falls, Niagara Radio. Rochester, Maseline Radio & Electronic Equipment, Rochester Radio Supply. Syracuse, Broome Distributing, Stewart W. Smith. Troy, Trojan Radio.

NORTH CAROLINA: Fayetteville, Eastern Radio Supply. Winston-Salem, Lambeth Electric Supply.

OHIO: Akron, Brighton Sporting Goods, Olson Radio Warehouse. Cincinnati, Holub & Hogg, Steinberg's. Cleveland, Pioneer Radio Supply, Progress Radio Supply, Radio & Electronic Parts. Columbus, Thompson Radio Supplies. Dayton, Standard Radio & Electronic Products. Lima, Warren Radio. Toledo, Toledo Radio Specialties, Warren Radio.

OKLAHOMA: Enid, Radio-Electronics.

OREGON: Portland, Bargelt Supply, Harper-Meggee, Lou Johnson Co., United Radio Supply.

PENNSYLVANIA: Altoona, Kennedy's Radio Supply. Erie, Warren Radio. Philadelphia, Almo Radio, M. & H. Sporting Goods, Radio Electric Service, Sanders Electronics, Eugene G. Wile. Pittsburgh, Radio Parts Co., Tydings Co. Reading, George D. Barbey Co. Scranton, Scranton Radio and Television Supply. Wilkes-Barre, General Radio. York, C. R. Minnich.

RHODE ISLAND: Providence, DeMambro Radio Supply.

SOUTH CAROLINA: Anderson, Electronic Supply.

TENNESSEE: Memphis, Bluff City Distributing.

TEXAS: Corpus Christi, Wicks-De Vilbiss. El Paso, Midland Specialty. Houston, R. C. Hall.

UTAH: Salt Lake City Standard Supply.

VIRGINIA: Norfolk, Radio Parts Distributing, Radio Supply.

WASHINGTON: Seattle, Harper-Meggee, Radio Products Sales, Seattle Radio. Spokane, Harper-Meggee. Tacoma, C & G Radio.

WEST VIRGINIA: Charleston, Hicks Radio Supply.

WISCONSIN: Madison, Satterfield Radio Supply.

CANADA

ALBERTA, Calgary, Taylor, Pearson & Carson. Edmonton, Radio Supply Co.
BRITISH COLUMBIA: Vancouver, Western Agencies, Victoria, Ellison Queale Radio Supply.

Principles of RADAR

by the M.I.T. Radar School Staff

Originally prepared for use in the basic portions of the war training courses in principles of radar given at M.I.T. where radar was born. The revised edition begins with a brief description of the components and functions of radar systems and continues with detailed discussion of typical system components. Expositions of circuits and devices provide an unusual combination of technically thorough and accurate treatments with minimum dependence upon mathematics.

CONTENTS: I. Introduction. II. Timing Circuits. III. Indicators. IV. Receivers. V. Magnetrons. VI. Modulators. VII. Triode Transmitters. VIII. Radio-frequency Lines. IX. Radar Antennas and Propagation. X. Wave Guides and Cavity Resonators. XI. Transmit-receive Devices. XII. Synchros and Servomechanisms.

Book No. MR10 **870 pages** **$5.00***

How to Get Radio Licenses

HOW TO PASS Radio License Examinations by C. E. Drew

A well illustrated and long-used question and answer manual for the coaching of candidates for the commercial radiotelegraph and radiotelephone operator license examinations.

Book No. DH20 **320 pages** **$3.25***

RADIO OPERATING QUESTIONS AND ANSWERS

by A. R. Nilson and J. L. Hornung

A practical study guide of the question-and-answer type useful for preparing for any of the radiotelegraph, radiotelephone, or amateur operator license examinations.

Book No. NQ10 **434 pages** **$3.50***

Here Are Books Every Radioman Needs

MATHEMATICS FOR ELECTRICIANS AND RADIOMEN by N. M. Cooke

This book presents all of the mathematics needed for a clear understanding of a.c., d.c., and high-frequency circuits and of electron tube operation. The text material covers the entire subject from simple arithmetic to logarithms, trigonometry, and vectors. It is an excellent book for the radioman who wishes to prepare himself for a more rigorous mathematical course. A wealth of illustrative examples and problems demonstrate applications of mathematical processes and reasoning to radio circuit investigation.

Book No. CM10 **604 pages** **$4.50***

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS by A. E. Knowlton and a staff of specialists

This 2303-page volume is the leading reference work for electrical engineers. Prepared by a staff of over 100 specialists, it contains 26 sections covering every phase of electrical engineering from units and conversion factors to electrophysics.

Book No. KH10 **2303 pages** **$9.00***

ELECTRICAL ENGINEER'S HANDBOOK

(Communications & Electronics Volume)

by Harold Pender and Staff

This is a complete and well organized collection of engineering and mathematical data for communications and electronic engineers. Numerous tables, charts, circuits, and illustrations.

Mathematics, Units and Symbols. Properties of Materials. Electric Circuits, Lines, and Fields. Resistors, Inductors, Capacitors. Electron Tubes. Electromechanical-Acoustical Devices. Circuit Elements. High-Frequency Transmission. Acoustics. Electrical Measurements, Telegraphy. Sound-Reproduction Systems. Telephony. Facsimile Transmission and Reception. Television, etc.

Book No. PH20 **1022 pages** **$6.00***

APPLIED ELECTRONICS

by M.I.T. Electrical Engineering Staff

A mathematical treatment of electronic theory with special emphasis on applications to communications circuits. This book is very complete and will be invaluable to the advanced student or practicing engineer.

Contents: Electron Balliatics. Electron Emission from Metals, Electrical Conduction through Vacuum, Gasses, and Vapors. High Vacuum Electron Tubes. Gas Tubes. Single-Phase Rectifier Circuits. Polyphase Rectifiers. Vacuum Tubes as Linear Circuit Elements. Class A Single-Stage Amplifiers. Cascade Amplifiers. Class A Amplifiers with Operation Extending beyond the Linear Range of the Tube Characteristic Curves; Class AB, Class B, and Class C Amplifiers. Vacuum-Tube Oscillators. Modulation and Demodulation, or Detection.

Book No. ME20 **772 pages** **$6.50***

PRACTICAL RADIO COMMUNICATION

by A. R. Nilson and J. L. Hornung

A complete radio manual covering subjects of interest particularly to the commercial radio operator. Topics include basic electricity; transmitters, receivers, and associated apparatus; and operating instructions. FM and ultra-high frequencies are included in this new edition. May be mastered by the average high school or trade school student.

Book No. NC10 **927 pages** **$6.50***

PRINCIPLES AND PRACTICE of Radio Servicing by H. J. Hicks

Explains operating principles of radio circuits and service test equipment, and outlines methods of shooting trouble in radio receivers and making repairs. A good book for the radio man anticipating entry into his own repair business.

Book No. HS10 **391 pages** **$4.00***

TELEVISION

by V. K. Zworykin and G. A. Morton

A complete treatise on electron optics and television transmission and reception, interspersed with occasional mathematics including calculus.

Book No. ZT21 **646 pages** **$7.00***

PRINCIPLES OF TELEVISION ENGINEERING

by D. G. Fink

A practical explanation of television receivers and transmitters. This book describes standard systems in simple language.

Book No. FT10 **541 pages** **$5.50***

ULTRA HIGH FREQUENCY TECHNIQUES

This book by professors of electricity at four different universities explains the principles that lie specifically in the u.h.f. field; a thorough foundation for all u.h.f. work, including every step from linear circuit theory to transmission lines, radiation, propagation and wave guides. A series of experiments is also outlined to demonstrate the phenomena described.

Book No. BU30 **534 pages** **$5.00***

INDUSTRIAL ELECTRONIC CONTROL

by W. D. Cockrell

Industrial electronics explained especially for the electrical worker who must install and maintain electronic equipment in factories, offices, and homes. The electrician, factory or office executive, and salesman may gain a quick understanding of basic electronic principles and of related equipment from a study of this book.

Book No. CC10 **247 pages** **$2.75***

PHOTOCELLS AND THEIR APPLICATIONS

by V. K. Zworykin and E. D. Wilson

This book will be invaluable to all persons who work with photocells or expect to. The style is lucid, and numerous industrial and scientific applications of the electric eye are described.

Book No. ZP20 **348 pages** **$3.50***

ELECTRON OPTICS AND THE ELECTRON MICROSCOPE by Zworykin, Morton, Ramberg, Hillier, and Vance

Book No. ZO20 **766 pages** **$10.00***

ELECTRIC CIRCUITS by M.I.T. Staff

Book No. MC20 **782 pages** **$7.50***

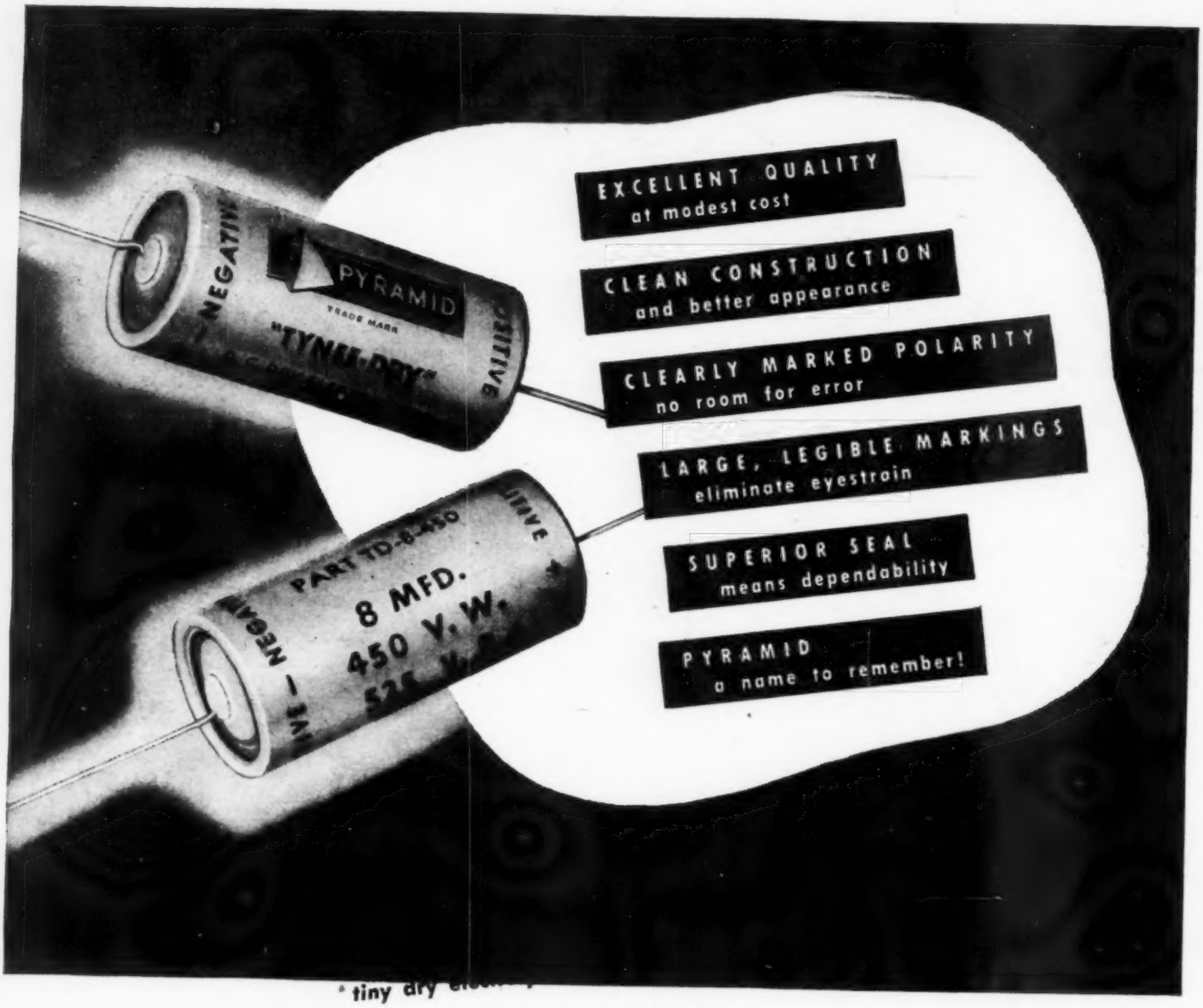
* Add 3% (minimum, 10c) for postage and packing; foreign, 10%. Prices are subject to change without notice.

The books listed in this ad (except some in col. 3 of the facing page) are distributed to the radio parts trade by the nation-wide wholesale service of

Editors and Engineers 1302 KENWOOD ROAD Santa Barbara CALIFORNIA

Save SPACE, TIME and MONEY!

with the PYRAMID "TYNEE-DRY"



* tiny dry

engineering and production controls provide maximum quality within minimum space—and at modest cost! Write for literature.

PYRAMID ELECTRIC COMPANY
JERSEY CITY 6, N. J.

PYRAMID
LONG-LIFE
Capacitors

MARCH, 1947

RADIO NEWS

RADIO-ELECTRONIC Engineering DEPARTMENT

TELEVISION

•

RADAR

•

ELECTRONICS

•

RESEARCH

•

COMMUNICATIONS

•

MAINTENANCE

RADIO NEWS

RADIO-ELECTRONIC Engineering DEPARTMENT

ELECTRONICS • COMMUNICATIONS • TELEVISION • RESEARCH • MAINTENANCE

MARCH, 1947

RADIO-ELECTRONIC ENGINEERING is published each month as a special edition in a limited number of copies of RADIO NEWS, by the Ziff-Davis Publishing Company, 185 N. Wabash Avenue, Chicago 1, Illinois.

VOLUME 8, NUMBER 3,

COVER PHOTO—by Walter Steinhard, Staff Photographer

Checking the electrical characteristics and screen quality of a 10-inch cathode-ray television tube at Sylvania Electric Products, Inc., Emporium, Pa. The operator is closely examining detail in a section of the trace with the aid of a magnifying glass. A careful check is made of a wide variety of patterns traced on the tube face.

By
GUS WALLIN, Ass't. Chief Eng.,
C. W. DYMOND, Senior Eng.
Galvin Manufacturing Corporation

V.H.F. TUNER DESIGN

The v.h.f. tuner, showing mechanism for adjusting the coaxial line cores.

An improved double superheterodyne tuner system for FM receivers, using permeability tuned coaxial lines.

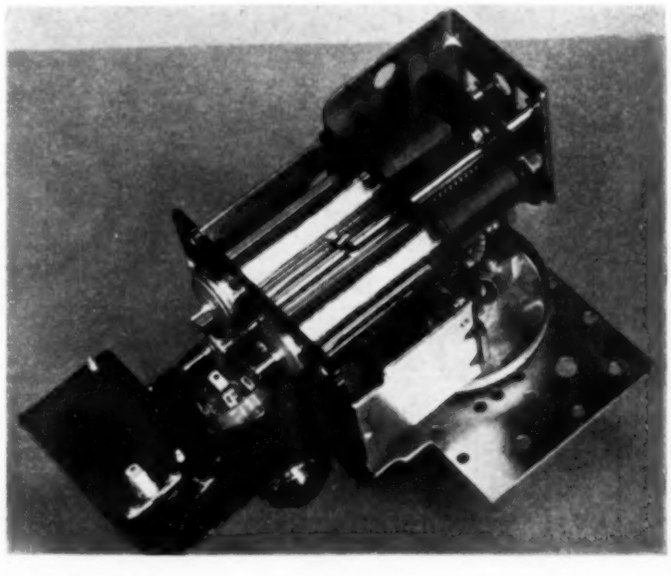
IN THE following paper, v.h.f. tuner design is viewed from the standpoint of the commercial receiver design engineer, confronted with the problems of the 88-108 mc. FM band.

Gang condensers and permeability tuners have been predominant in broadcast and short-wave band receiver design, and their use has been extended to the FM band. Whereas these types have been widely used in the lower frequency bands, certain inherent characteristics of each make their successful adaptation to the new FM band difficult. The problems associated with these characteristics are discussed and subsequently a new approach, which circumvents these problems, is described in detail.

One of the major problems of v.h.f. design is the input loading of vacuum tubes which manifests itself as a relatively high input conductance. For typical pentode amplifiers, this conductance at 100 mc. may be the equivalent of shunting the grid circuit with a resistor of 1000-3000 ohms. During the war, special tube types were developed (6AK5) in which this effect was reduced considerably so that the equivalent shunt input resistance was increased to about 10,000 ohms at 100 mc. (At the present writing, however, these tubes are so expensive as to make their use prohibitive, except in the costliest console type receivers.) As input conductance, for a given tube, is directly proportional to *Gm*, tubes used as converters will exhibit higher input resistances.

Oscillator stability includes the thermal effect of tube warm-up as well as the heating of other circuit components and the effects of filament and plate supply variation. Data taken on a pentagrid converter, designed for use at 100 mc., indicates warm-up drift, in the first ten minutes of operation, amounting to 65 kc. This circuit used a capacity of 35 $\mu\mu$fd. and a coil of 0.07 microhenrys inductance. Since an inch of No. 10 AWG straight wire has an inherent high frequency inductance of 0.015 microhenrys, the limitations of increasing tuning capacity through reducing coil inductance are evident. The use of second harmonic injection has been proposed as a means of reducing warm-up drift, but this method has disadvantages with respect to introducing additional spurious responses. Heating causes changes in the tuned circuit coil and condenser with a subsequent shift in the frequency of oscillation. Usually these changes are of a relatively large magnitude and require temperature compensation. Variations in thermal lag of the circuit components increase the difficulties of proper compensation. Power supply variations provide a frequency change of about 2 kc. per

The tuner with tuning cores partially removed.



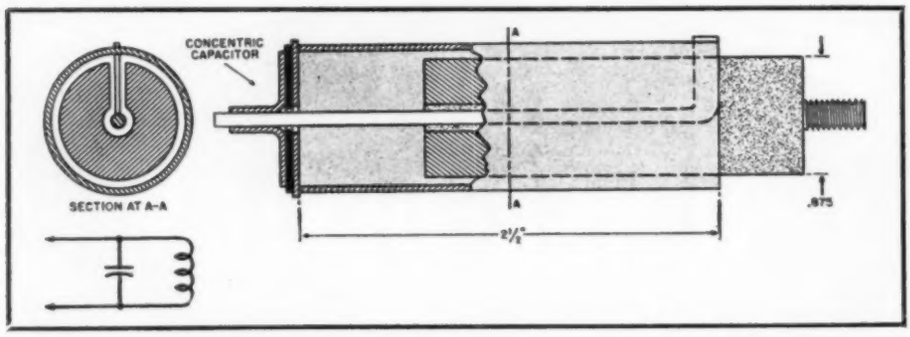


Fig. 1. Permeability tuned coaxial transmission line.

volt of change in the "B" supply and 14 kc. change for a drop of one volt in the filament supply.

Undesirable coupling between the sections of a gang condenser acquires increasing importance in the 100 mc. region. Some of the effects of such coupling include oscillator voltage coupling to the r.f. or antenna circuit and common impedance coupling of antenna and r.f. circuits. Since the gang is usually grounded to the chassis, common chassis paths offer another undesired coupling. Chassis pickup of undesired voltages and subsequent introduction of these voltages into tuned r.f. circuits, other than the antenna, degrade spurious response rejection ratios as measured at the antenna terminals.

Oscillator radiation is considerably augmented by the coupling referred to above and is serious because of the efficient radiation by the commonly-used doublet antenna, as well as by the chassis. Blocking or tuning a neighboring receiver by means of oscillator radiation is a problem.

Microphonics are a source of distortion in the FM receiver. Gang condensers are particularly susceptible and in view of the low capacities required in the FM band, it is not difficult to provide a high frequency deviation with only a slight motion of the condenser plate.

Lead inductances become an important factor in v.h.f. design. Their presence necessitates physical proximity of tubes and tuned circuits in order to avoid spurious resonances. Switching of tubes for use in other bands adds further to such problems because of added lead lengths.

From the commercial designers' viewpoint, ease of duplication for production purposes is important. In this connection, the use of physically small coils, of the order of ¼ to ½ inch in diameter and composed of 3 to 5 turns, presents a problem.

With a view to favorable consumer acceptance, certain characteristics should be incorporated in the design. The triple response typical of FM tuning makes it highly desirable to eliminate the two side responses or at least to attenuate them. The wide acceptance of push-button operation in the broadcast band indicates the desirability of including this feature in the FM band. Oscillator warm-up drift should be eliminated or at least reduced to the point where audio distortion does not result.

The evolution of a new approach to the problem is discussed in the form of a project which was to provide, as simply as possible, a means for receiving both the 42 to 50 mc. and the 88 to 108 mc. frequency-modulation bands. Emphasis was to be placed on providing maximum performance characteristics in the 88 to 108 mc. band. The design had progressed several months when the FCC opinion obviated the low frequency requirement.

Two principal electrical requirements of the tuner which seemed the most difficult to satisfy were:

1. Image rejection to be 60 db.
2. Oscillator stability of the order permitting satisfactory push-button tuning.

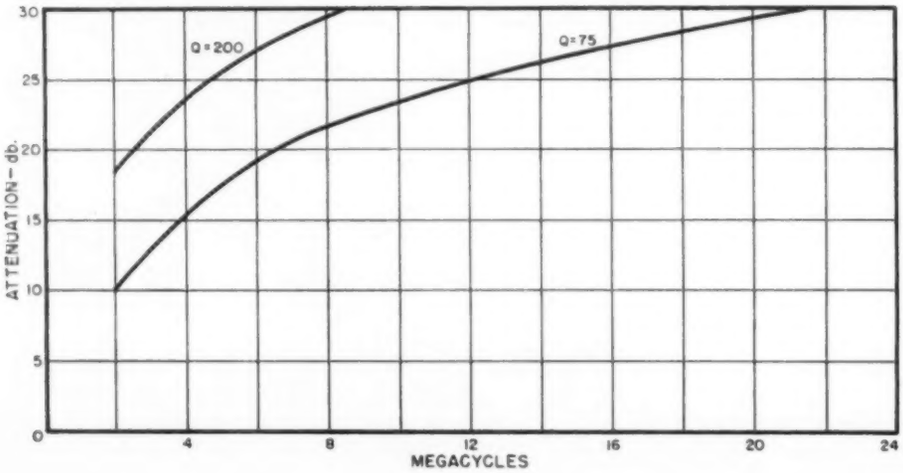
An attenuation of 60 db. is required in order to suppress the image response, since the frequency bands adjacent to the 88-108 mc. band are allocated to services which could cause objectionable interference.

The design of an oscillator circuit embodying the required frequency stability involves two considerations. The first is that of warm-up drift which may be minimized by making the tuned circuit capacitance high in comparison with the tube capacitance. Tube changes during warm-up will then have a negligible effect upon the frequency of oscillation. The second is that of the temperature coefficients of the elements associated with the tuned circuit. In this connection, it is of interest to note that typical coils used in this frequency range are subject to a relatively large temperature coefficient characteristic. Furthermore, close duplication in production of this characteristic is impractical, so that use of a fixed value compensating condenser does not satisfy the requirement of good temperature stability. In addition, commercially available compensators require: (1) a capacity tolerance of plus or minus 10% or plus or minus 1 $\mu\mu$fd., whichever is greater; (2) a tolerance of plus or minus 15% on the temperature coefficient. When compensators of large temperature coefficients are used, these two factors taken alone can produce more frequency drift than is tolerable for push-button operation. Therefore, it is evident that the tuning elements of the oscillator circuit should have a very low inherent temperature coefficient.

Two or more tuned radio-frequency circuits, in addition to the oscillator, are indicated depending upon the choice of intermediate frequency Choosing two tuned circuits as an economic compromise, it is apparent from Fig. 2 that for a 10.7 mc. intermediate frequency, the required effective Q per circuit to give 60 db. image attenuation, is approximately 75. For a 4.3 mc. intermediate-frequency, the required effective Q per circuit is approximately 200.

On the other hand, the maximum stable stage gain is greater for a 4.3 mc. intermediate frequency by the ratio of $\sqrt{10.7/4.3}$ or 1.57[1]. Therefore,

Fig. 2. Image attenuation vs. intermediate frequency for single tuned v.h.f. circuit.



in order to gain the advantage in using a 4.3 mc. intermediate frequency it becomes necessary to provide relatively high Q circuits in the radio-frequency tuner.

Turning, for a moment, to the consideration of pentodes generally available for radio-frequency amplification, the data indicates input resistances of the order of 1000 to 3000 ohms. In order to provide a coil of reasonable physical size, the tuning capacity should not exceed 30 to 40 $\mu\mu$fd. at 100 mc.

Assume, for example, an input circuit consisting of an ideal coil having infinite Q resonated to 100 mc. with 35 $\mu\mu$fd. The loading of a tube having 2000 ohms input resistance reduces the effective Q of the circuit to 44. This does not include the factor of antenna loading which would result in a further reduction in Q. It is therefore impossible to obtain the specified image attenuation with this arrangement.

In the case of converters, the input resistance may be of the order of 7000 to 12,000 ohms. In order to approach the desired effective Q it becomes necessary to operate the circuit into a converter instead of an amplifier, to use a high value of tuning capacity, and to use high Q elements.

Transmission lines provide such high Q, low inductance elements. The choice of line configuration is governed by two factors:

1. Optimum anti-resonant impedance.
2. Required Q.

The length of the line is chosen to give the desired inductance. Terman[2] has shown that, for a coaxial line, the maximum anti-resonant impedance attains for an outer to inner conductor ratio of 9.2 to 1. Since this characteristic is relatively flat, a 10 to 1 ratio is used.

Assuming a maximum impedance (10 to 1 conductor ratio) coaxial transmission line with an inner conductor diameter of 0.080", the Q of the line at 100 mc. is 640. A 60 $\mu\mu$fd. tuning capacity resonates with 0.031 microhenrys at 115 mc. and requires a 2.65" length of line. Since the magnitude of inductance is low, the use of a gang condenser for tuning, with its inherent inductance and common impedance paths, seems a poor choice. Permeability tuning of the transmission lines has been chosen for this application.

Recent developments in powdered iron have resulted in the production of very low loss cores with relatively high permeabilities. Consider a coaxial line and an iron core of the configuration shown in Fig. 1. The apparent permeability with the core inserted 1⅞ inches is 1.75. The Q with iron at 100 mc. is 335. The tube load reduces the effective Q of the circuit to 195. When the antenna loading is taken into consideration the net Q of the circuit is somewhat lower.

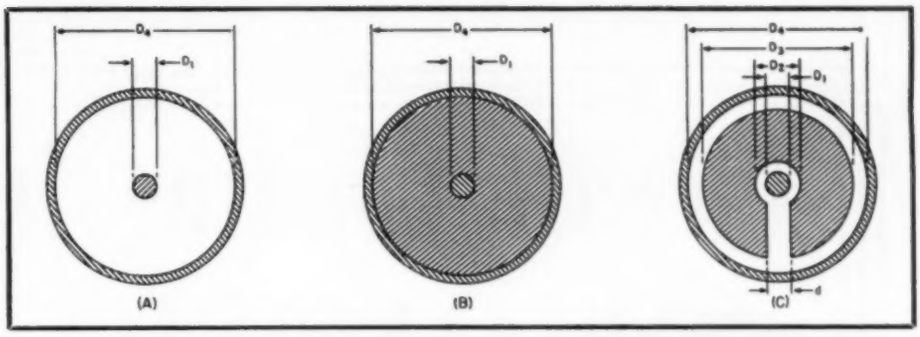


Fig. 3. Cross section of coaxial transmission lines having magnetic medium of (A) air, (B) powdered iron, and (C) air and powdered iron of the configuration used in v.h.f. tuner.

One of the features of this type of coaxial construction is that the units can be fabricated as a mechanical assembly, without the necessity of electrical checking. Using materials with maximum commercial tolerances on the inner and outer conductor diameters the variation in inductance was found to be plus or minus 1/2% from nominal.

An inexpensive high quality concentric condenser was developed for this application. It is indicated in Fig. 1. This condenser is of silver on mica construction. The Colpitts oscillator circuit necessitated development of a dual concentric condenser illustrated in Fig. 4.

One of the inherent and very desirable features of the coaxial line and condenser type of construction consists in that the tuned circuit is integrated, as contrasted with the coil and condenser used in conventionally tuned circuits. This makes for a very high degree of uniformity in production. In addition, this characteristic reduces considerably the importance of inductance present in leads connecting the tuned lines in the circuit.

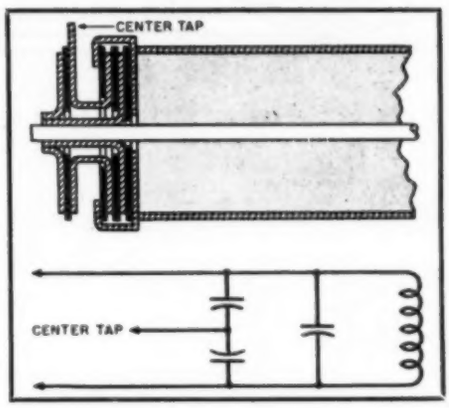


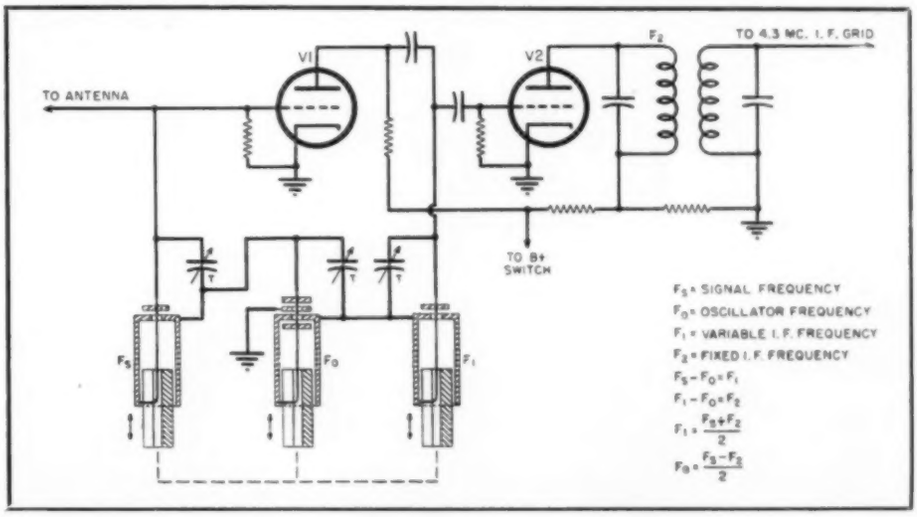
Fig. 4. Permeability tuned coaxial transmission line used in oscillator circuit.

At 100 mc., the problem of confining the desired signal pickup to the antenna terminals of the receiver becomes increasingly difficult. Such factors as chassis pickup and undesired antenna effects combine to degrade the image and adjacent channel attenuation as measured at the antenna terminals. This type of construction obviates chassis paths in series with tuned circuits. As a result, undesired pickup is so negligible that removing the antenna, in the presence of a strong field, completely eliminates any response.

The inherent advantages of the tri-

(Continued on page 25)

Fig. 5. Functional schematic of v.h.f. tuner showing frequency relations.

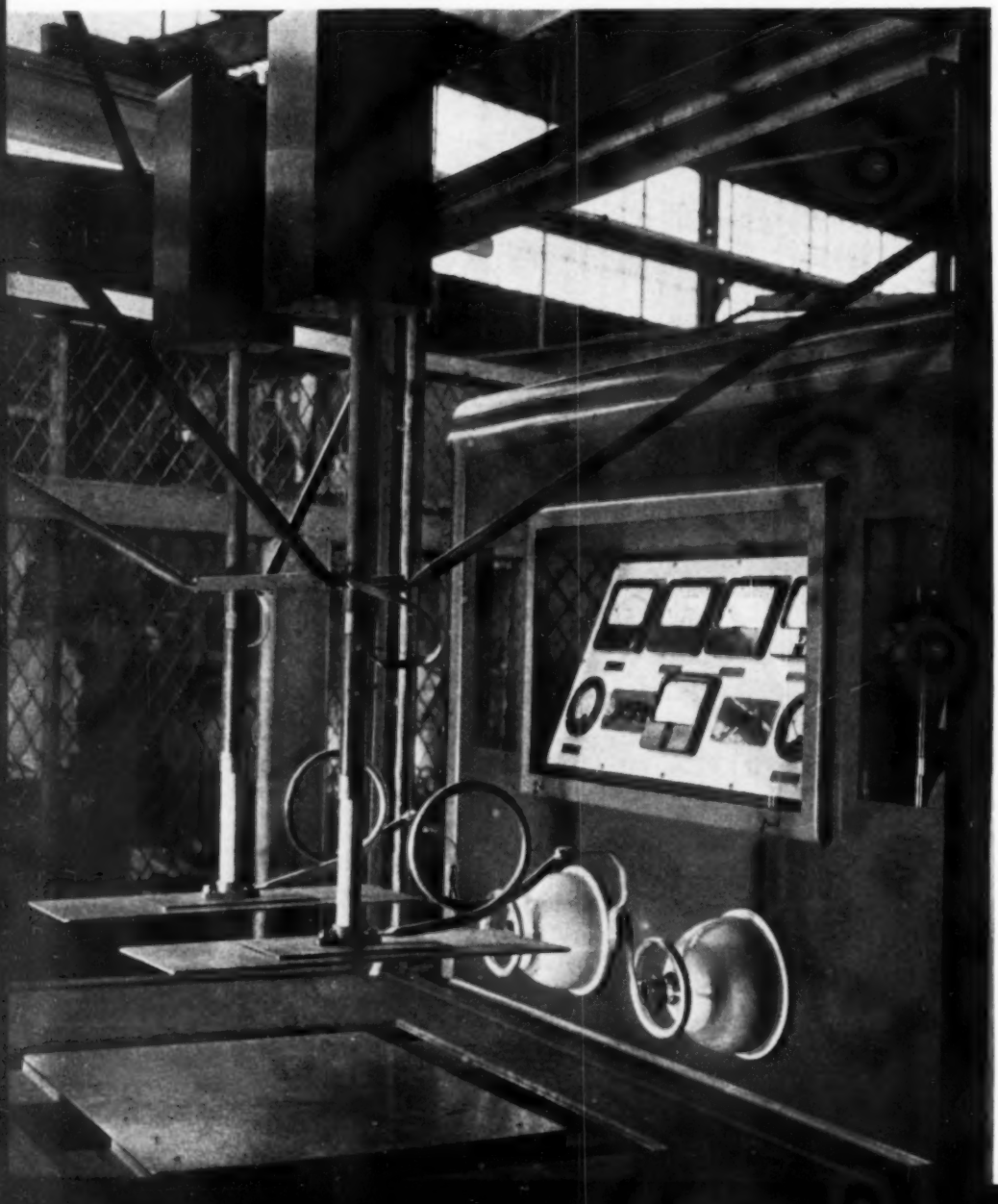


Circuit Loading in DIELECTRIC HEATING

By E. MITTELMANN and R. A. WHITEMAN
Consulting Engineers

Dielectric heating may be improved if circuit loading is kept at the optimum value throughout the heating cycle.

Fig. 1. A dielectric heating unit incorporating the automatic adjustment feature where α is infinity and β is adjusted during the heating cycle.



IN THE practical application of dielectric heating, one is confronted with the fact that the same generator will be used for a great variety of loads of different physical dimensions and of different electrical properties, and, furthermore, that the physical properties of any load, such as the dielectric constant and the power factor, will change during the heating cycle. This means that the generator is to deliver power to a load of variable electrical impedance.

The principal effects of a variable dielectric load upon the output of the radio-frequency power oscillator are variable power output and variable efficiency.

Only when the equivalent dynamic impedance of the generator matches the load impedance will maximum power be delivered to the load at a selected efficiency of the generator. Equipment to satisfy these conditions was described by one of the authors on a previous occasion.[2, 3, 4]

This article considers the suggested methods of load adjustment of changing the coupling between the power oscillator tube and its associated dielectric load.

The equivalent circuit for the dielectric load itself is illustrated in Fig. 4 where R represents the equivalent series resistance and C represents the capacity of the load. The resistance R is the effective resistance responsible for the power dissipation. It was shown on previous occasions that the power dissipated in the load can be represented by Eqt. (1):

$$P = E^2 \omega C \cos \varphi \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

and that the relationship (2) exists between the power required per cubic inch of the material for certain temperature rise per minute. This relationship:

$$W = EI \cos \varphi = E^2 \omega C \tan \delta_L \quad \ldots\ldots\ldots (2)$$

is plotted in Fig. 3[1]. To obtain the desired output power from a radio fre-

quency vacuum tube generator with a satisfactory efficiency, it is well known that the load impedance presented to the tube by the external load must be of a certain value. This load impedance is a function of the operating potential of the tube and there is only a narrow range of load impedances which will satisfy the requirements of loading the tube to the rated output power with good efficiency. To analyze these conditions, reference is made to Fig. 6. In this circuit C_1 may be the filament to anode capacity of the tube itself or the total fixed capacity between filament and anode. L is the tank inductance, whereas C_2 represents the variable coupling between the oscillator tube and its tank circuit and the load represented by the capacity C_L and R.

For such a circuit it was shown by L. Grinstead in a publication of the Journal of Proceedings of the Institute of Radio Engineers[1] that the equivalent load resistance presented to the tube is defined by Eqt. (3):

$$R_L = \frac{K}{\tan \delta_L} \sqrt{\frac{L}{C_1}} \text{ kilohms} \quad \ldots\ldots\ldots\ldots (3)$$

where the factor K is expressed by Eqt. (4):

$$K = \frac{(\alpha + \beta)^{3/2} (\alpha + \beta + \alpha\beta)^{1/2}}{\alpha^2 \beta} \quad \ldots\ldots (4)$$

and

$\alpha = C_2/C_1$

$\beta = C_L/C_1$

$\tan \delta_L$ = power factor of dielectric load

L = inductance expressed in microhenrys

C_1 = capacitance in micromicrofarads.

The relation given by Eqt. (3) is extremely important and a number of very useful design and operational features follow directly from it. However, before discussing these features in detail, it is well to consider the derivation of this equation and thereby become acquainted with the fundamental assumptions made in order to obtain this simple expression. It is quite natural to expect that the information obtained from Eqt. (3) will not coincide with the results of a particular application, if in this application one or more of the assumptions are not satisfied. For this particular reason the assumptions will be stressed throughout the derivation.

To determine the load resistance R_L presented to a power-oscillator tube by a circuit of the type shown in Fig. 6, first assume that the frequency of operation is equal numerically to the frequency which yields a capacitive reactance equal to the inductive reactance within the circuit. Or stating the same thing more simply, the power factor of the circuit across the output of the tube is unity. In actual practice this is not quite correct, but approximates a value of 0.985 instead of 1.0.

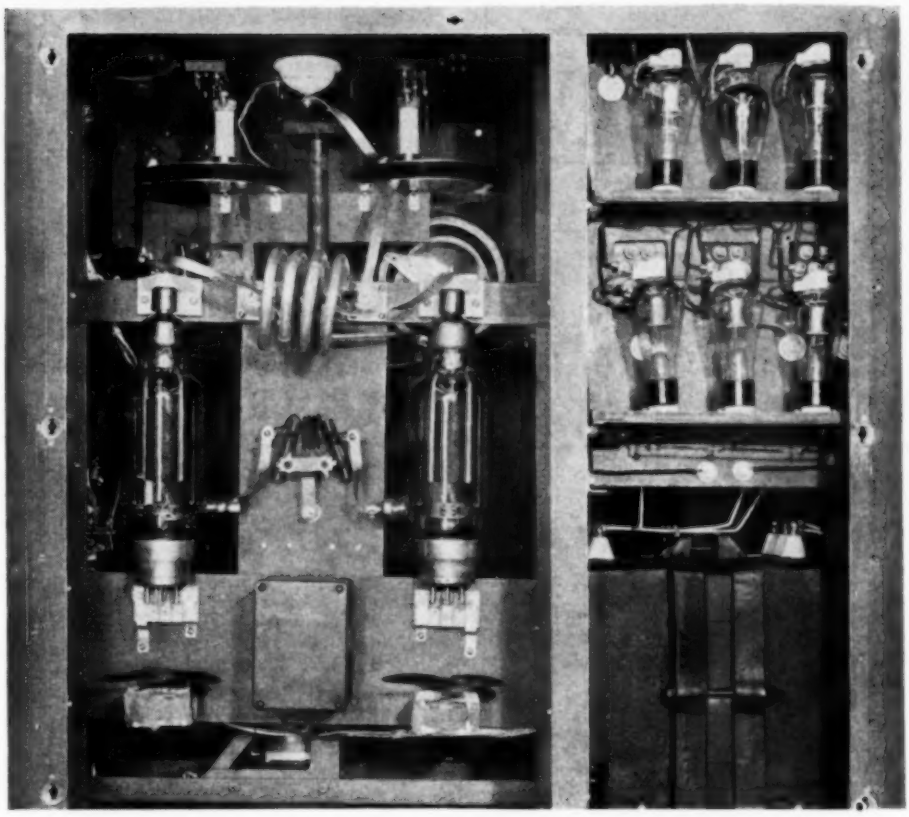


Fig. 2. Oscillator section of high frequency dielectric heating unit showing capacitors C_2 which are used for automatic circuit load adjustments during heating cycle.

At the assumed frequency of operation, the effective resistance R' and the effective reactance X_C' of the circuit combination of the condenser C_1, C_2 and C_L with the resistance R are:

$$R' = \frac{X_{C1}^2 \, R}{X_C^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$X_C' = \frac{X_{C1} (X_{C2} + X_{CL})}{X_C} \quad \ldots\ldots\ldots\ldots (6)$$

For these conditions, the value of R_L is simply expressed by:

$$R_L = L/C'R' = X_L \, X_{C'}/R' \quad \ldots\ldots\ldots (7)$$

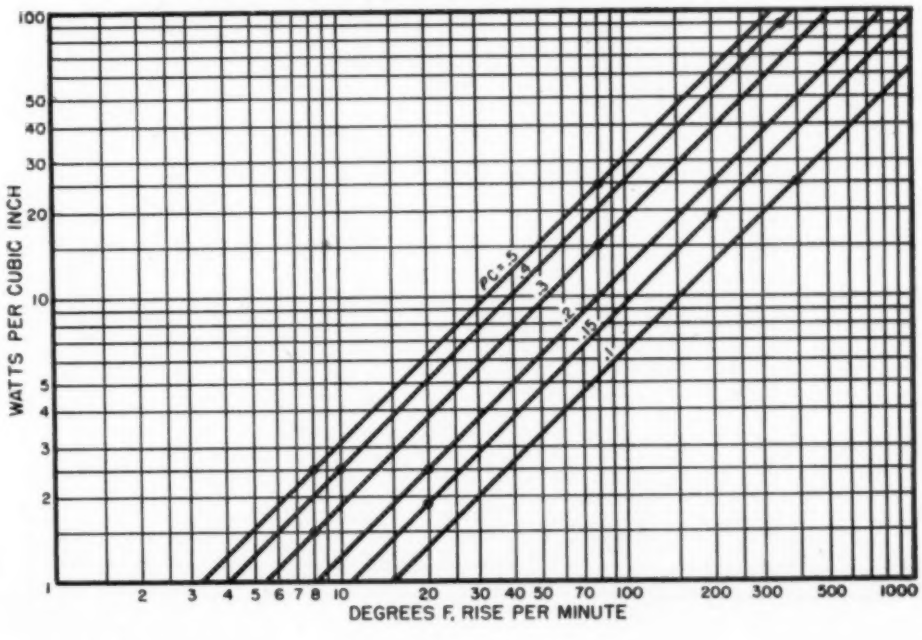
then since:

$$X_{C'} = \frac{X_C (X_{C2} + X_{CL})}{X_C} \quad \ldots\ldots\ldots\ldots (8)$$

and neglecting the effect of resistance upon the frequency formula satisfying the unity power factor condition:

$$\omega^2 L \left(C_1 + \frac{C_2 C_L}{C_2 + C_L} \right) = 1 \quad \ldots\ldots\ldots (9)$$

Fig. 3. Relation between the required power concentration for various materials to obtain a specified rate of temperature rise.



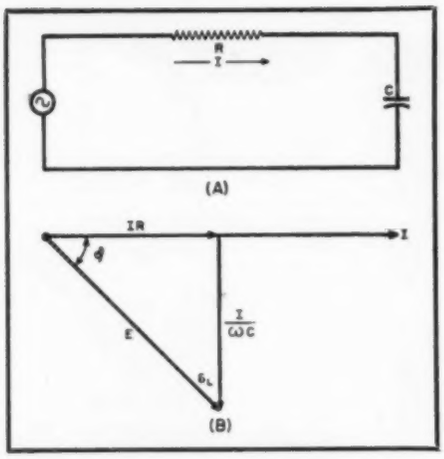


Fig. 4. (A) Equivalent circuit of dielectric load. (B) Vector diagram of voltages and currents.

With these equations and Eqt. (4), the final and simplified relation for R_L reduces to Eqt. (3).

By plotting the two sets of graphs for K vs. tan δ_L and K vs. β in the form of a single chart as shown in Fig. 5, the functional relations can be observed very readily as the operating parameters change. This change may apply to a specific equipment during a heating cycle or it may apply to different equipments.

In order to observe the usefulness of this chart, consider the first type of application, namely, the study of a particular equipment during the heating cycle of a typical plastic or dielectric material. This will require the assignment of values of β and tan δ_L and then the operating point on the chart can be traced throughout the heating cycle. Consider that the initial and final values of β are 10 and 19.2 while the initial and final values of tan δ_L are .025 and .035. The performance of the circuit shown in Fig. 6 will be analyzed by considering the following different cases:

(1) All circuit elements such as L, C, and C_2 as constant throughout the dielectric heating cycle with α initially small.

(2) All circuit elements such as L, C, and C_2 as constant throughout the dielectric heating cycle with α initially large.

(3) The circuit element C_2 as adjustable and L a constant.

(4) The circuit element L as adjustable and C_2 a constant.

(5) The circuit element C_2 is infinite and C_L is adjustable, meaning that α is infinite and β is adjustable.

Now consider case (1) with the value of α equal to 2. The initial point of operation in the K-β plane is determined by β equal to 10 and is shown by point A_1. The corresponding value of K as determined by the chart is 5.85. With the initial value of tan δ_L equal to .025 as previously specified, the initial point of operation in the K-tan δ_L plane is A_3 and lies on the line L/C_1 equal to .0018. Now consider the points of operation to move to the final values already specified. Then the point at A_1 will move along the curve determined by α equal to 2 as β changes to 19.2, finally arriving at the point marked A_2. The value of K corresponding to this value of α and β is 9.85. During the same time interval the operating point in the K-tan δ_L plane moved from A_3 to A_4, whereas it should have moved to A_5 in order to maintain a substantially constant value of R_L. This would mean that for a particular equipment, the dielectric material would require that its dielectric constant and power factor vary between certain initial and final values in order to maintain a satisfactory loading throughout the heating cycle. Conversely, a given dielectric material requires a certain designed equipment in order to have a satisfactory loading throughout the heating cycle without adjusting the circuit elements.

Referring to case (2), consider the similar conditions to case (1) except the value of the parameter α is larger, such as 10. The initial point in the K-β plane is B_1 and the corresponding value of K is 1 while the final value of K is 1.32 determined by B_2. By referring to the K-tan δ_L plane of the chart, the change in position of the operating point is from B_3 to B_4 whereas in order to maintain a loading with substantially constant R_L, the point only has to move to B_5. It is noted that when α equalled 2 the operating point did not reach the desired point A_5 but when α equalled 10, the operating point passed the desired point B_5. This fact indicates that for some value of α between 2 and 10 the final point and the desired point in the K-tan δ_L plane coincide. Under this condition, the loading would remain approximately constant without the adjustment of C_2 or L. This can be satisfied only when:

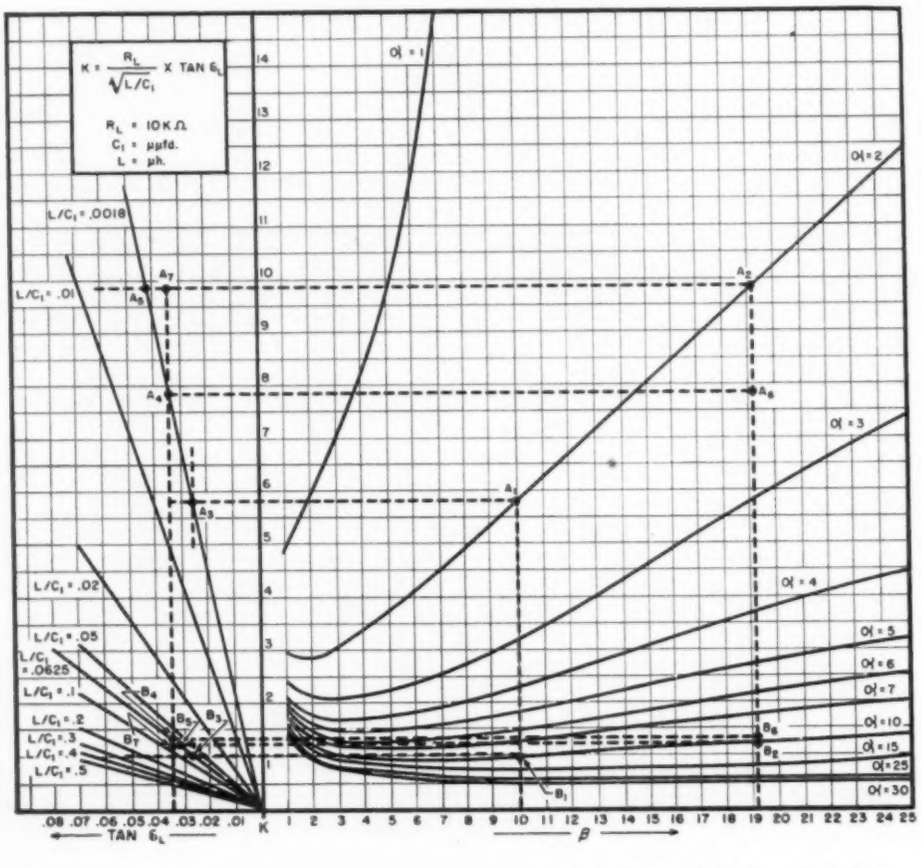
$$\int_{\delta_1}^{\delta_2} \frac{dK}{d\tan\delta} \cdot d\tan\delta = \int_{\beta_1}^{\beta_2} \frac{dK}{d\beta} \cdot d\beta \quad \ldots\ldots (10)$$

In case (1), the left member of (10) was less than the right member, while in case (2) the left member was greater than the right number.

Now consider case (3) with C_2 adjustable and apply this condition to the parameters in case (1) and case (2). In the modified case (1) the operating point in the K-β plane would have to shift from 2 to 2.5 during the heating cycle. This amounts to about a 25 per-cent increase in C_2 during the cycle. For the modified case (2), however, the terminating point would be B_6 and α would have to change from 10 to 9. This amounts to about

(*Continued on page* 30)

Fig. 5. Two sets of graphs (K vs. tan δ_L and K vs β) on a single chart for observing the functional relations as the parameters change.



ELECTRONIC CRYSTAL CLOCK

By
VINCENT E. HEATON
National Bureau of Standards

Front view of Seconds Pulse Generator and Time Interval Selector used in the time control equipment of the Bureau's radio station, WWV.

The output of a highly accurate standard crystal oscillator is subdivided to a 60 cycle frequency.

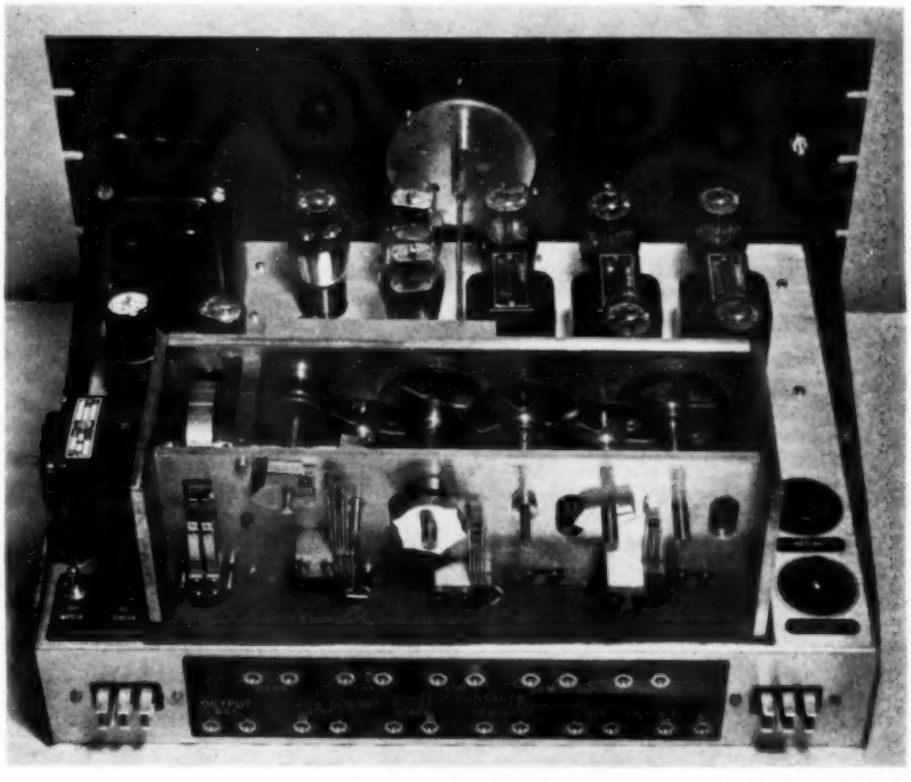
THE demand for time interval signals accurate to a microsecond in navigation, seismology, and geological surveys, led to the development of the crystal clock, utilizing electronic circuits instead of conventional clock mechanisms. Developed by the National Bureau of Standards, the crystal clock is now broadcasting second time pulses throughout the world—the only continuous time signal service provided by any country. One or more of the frequencies broadcast continuously (5, 10, and 15 megacycles per second and 2.5 megacycles at night) may be received on the usual short-wave radio receiver. These highly accurate time signals which proved of great assistance to the Armed Forces in World War II, are now providing an expanding peacetime service to scientific laboratories, schools, and industry.

The heart of the Bureau's crystal clocks consists of a flawless crystal of quartz with a series resonance frequency of approximately 100,000 or 200,000 cycles per second. By electron-tube circuits the crystal is continuously oscillated and the resulting frequency is divided with no loss of accuracy to 60 cycles per second. This 60-cycle frequency supplies power to a synchronous motor which, through gear trains, drives contacts that give intervals of one minute, five minutes, and thirty minutes to control the automatic announcement equipment of the transmitters. The motor also operates a one-second contact which opens an electrical gate and allows a highly accurate seconds pulse to be broadcast.

The accuracy of the seconds pulse does not depend on the closing time of the contact. The accuracy is determined by the crystal oscillator frequency which controls a square-wave generator and the adjustment of this generator which supplies voltage to an amplifier during alternate 1/200th second intervals. A standard 1000-cycle frequency is fed into the amplifier so that the output consists of

(*Continued on page* 21)

Rear view of unit. The one-second contact is made by a cam on the flywheel immediately to the right of the electric motor. Succeeding cams are for longer time intervals.



Five tubes of the new A series (Rimlock tubes) designed for a normal receiving set. Left to right: UCH41, a triode-hexode; OF 41, i.f. pentode; UAF 41, a diode-pentode; UY 41, a rectifier; and UL 41, a 9 w. output tube.

New Series of SMALL RADIO TUBES

Techniques developed by Philips of Holland for manufacturing tubes having a diameter of 20.5 mm.

ALTHOUGH for a number of years already radio tubes have been manufactured which, as far as internal structure and form of the envelope (bulb and current leads) are concerned, may be considered rational in every respect, there are nevertheless various tendencies in the radio field which have called for a further development in tubes. In the first place there is the great interest in small, inexpensive sets evidenced in the markets of most countries. In the second place the region of short and very short waves is steadily becoming more important, due in part to the fact that in some countries television is finding its way into the home.

In order to be able to build small sets, the radio valves and other parts to be employed must be made as small as possible. In this respect the last 7 or 8 years have produced a remarkable development. Two stages in this process of development of radio valves have already been the subject of other papers.[1, 2] In the new series of radio valves now developed by *Philips* the reduction in size compared with previous series is again one of the most striking features. As we shall explain in this article, this reduction in size, with the accompanying endeavor to obtain at the same time good properties of the tubes for short waves, has been made possible mainly by a new technique in the manufacture of the envelope.

In the case of tubes which are to be used for short-wave reception (and if desired also for ultra-short-wave) it is essential among other things that the mutual capacities between the leads to the various electrodes should be very small and that only small dielectric losses should occur in the insulation material between those leads.

In an earlier stage of development of tubes an important advance in this direction was obtained by abandoning the original "pinch" construction for a bulb with a flat base.[1] As a result the lead wires became much shorter and only needed to pass through the glass of the bulb for a short distance and far apart. At the same time the leads through the base could themselves be constructed as contact pins, so that the socket of plastic material, which caused high and most variable losses, could be omitted. The short total length of the leads, moreover, led to a proportionally smaller self-induction, opening new possibilities for the use of tubes of this type for very high frequencies (meter waves).[3]

Up to this point the intrinsically desirable decrease in the tube dimensions and the likewise desirable improvement in the qualities for short waves ran parallel. Upon further development, however, these desired qualities are found to be in conflict. For a considerable decrease in size of receiving sets it was necessary to limit the diameter of the tubes—which determines for the greater part the area of chassis required for a receiver—but this involved a shorter interval between the contact pins in the flat base of the tubes and thus an increase in their mutual capacities and in the dielectric losses. This objection made itself most plainly felt in that type of tube where the wall of the bulb as well as the flat base were made entirely of metal and the contact pins were fused into the base with glass beads. In this metal construction, the improvement obtained in respect to capacities of losses was partly lost again, and it offered little prospect of a possible further decrease in the diameter of the bulb. An important advantage, however, which these tubes possessed over the type made entirely of glass lay in the process of manufacture. In order to fuse the base plate, on which the electrode system is assembled, to the bulb, the edges of bulb and plate in a glass tube have to be heated to a temperature of about 800 to 900° C. The shorter the leads and the narrower the bulb, the closer the parts of the electrode system come to lie to the seal and the higher is the temperature to which they are raised during the fusing. Thus if it is desired to make very small tubes, there is a great risk that during the fusing some parts will become oxidized and

Condensed from an article by G. Alma and F. Praake entitled "A New Series of Small Radio Valves" which appeared in the October, 1946, issue of Philips Technical Review.

the cathode will be attacked ("poisoned"), thereby impairing its emission. Consequently one has to reckon with a larger number of rejections in manufacture, or else cause some non-oxidizing gas (for instance nitrogen) to pass through the bulb during the fusing, which makes the manufacture more complicated. In the case of a metal tube, on the other hand, the joining of the bulb and base plate is accompanied by only very slight increases in temperature of the electrode system. Here the junction is made with the help of a heavy welding machine which with a single current impulse sets up in the edges to be sealed an accurately calculated amount of heat which, due to the good heat conductivity of the metal parts, is quickly conducted away to the welding electrodes and the surroundings.

As explained in the foregoing, both in the case of metal tubes and in that of glass radio tubes, a difficulty is encountered when one attempts to make them smaller: in the case of the metal tubes the short-wave properties depreciate, in that of the glass tubes trouble is encountered in the sealing process. A solution has now been found in the retention of glass as material for bulb and base plate, but joining these up by a new process entirely different from that hitherto followed. Bulb and base plate are jointed together by means of a kind of glaze with a softening point considerably lower than that of the glass, this glaze acting as an "adhesive." After the glass base plate with its contact pins has been moulded, a ring of moulded glaze powder is laid around the edge of the plate. In the following process, namely the heating and the slow cooling of the plate, thereby removing the mechanical stresses in the glass, the powder melts and the layer of glaze is firmly bound to the glass (see Fig. 3). The various electrodes are then assembled on the base plate, and with the help of a special sealing machine, the edge of the bulb is "glued" to the layer of glaze. This is done by setting the base plate with ring of glaze loosely on the edge of the inverted bulb and heating the whole to such a temperature that the glaze becomes soft. The base plate then sinks by its own weight far enough for the edge of the bulb to penetrate the layer of glaze, so that after the glaze has set again it adheres firmly to it and forms a vacuum-tight seal (Fig. 5). In this operation, in which the glaze but not the glass has to be softened, a much less high temperature is needed than in the direct fusing together of the glass parts. For the glaze used for the new tubes now in course of manufacture a temperature of about 450° C is sufficient. The electrodes in the new, small tubes, in particular the cathode, thereby reach a temperature of not more than 230° C, while with the same tubes and the former method of sealing, the temperature of the cathode was 500 to 600° C.

Fig. 2. For comparison purposes, left to right: EFF 50 (36 mm. in dia.); ECH 21 (32 mm. in dia.); and the new UCH 41 (22 mm. in dia.).

In order to avoid the risk of dangerous mechanical stresses being set up while cooling down after the sealing, the glaze must have a coefficient of thermal expansion practically equal to that of the glass used for the bulb and the base plate. Moreover by using certain admixtures it has to be ensured that the surface tension is suitable. For the method of manufacture described it is necessary that the meniscus of the layer of glaze in Fig. 3C shall have a certain slightly concave shape, so that the base plate cannot slide off to one side when it is set on the bulb (Fig. 5A). Fig. 6 shows a detail of the machine used to "glue" the bulb to the base. A metal cap is hung over the upward projecting contact pins of the loosely placed base plate. It then passes between two rows of flat flames directed radially towards the cap. The edge of the bulb and the base plate are thus heated uniformly, so that no mechanical stresses arise in the glass. The weight of the cap helps the edge of the bulb to penetrate well into the layer of glaze.

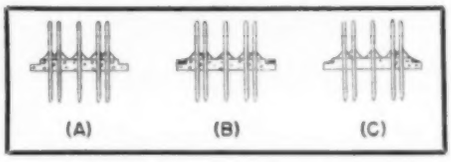


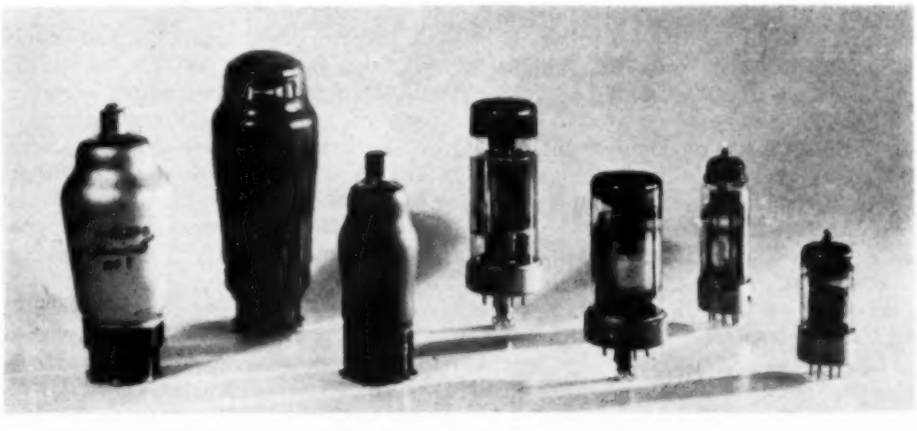
Fig. 3. (A) Base plate with moulded-in pins. (B) Same plate with ring of glaze laid on it. (C) Ring of glaze fused to the glass.

Thanks to this glazing technique it has proved possible to make the new series of tubes, known as *A* series (or "Rimlock" tubes) with a base diameter of 22 mm. and a bulb diameter of only 20.5 mm. For the sake of comparison the *B* series has a diameter of 32 mm., the *C* series (among which is the short-wave push-pull pentode EFF 50) a diameter of 36 mm.[2] Some of the tube types made by the *B* or *C* technique cannot be considered for application of the *A* technique; we shall return to this later. In Fig. 1 a series of tubes in the *A* technique is shown, in Fig. 2 an *A* tube together with a *B* and a *C* tube. The reduction in size is best illustrated by Fig. 4, where four successive models of two different tube types, namely an intermediate-frequency pentode and an output pentode with about the same performance, are shown side by side.

In addition to the possibility of

(*Continued on page* 29)

Fig. 4. Successive models, with about the same performance, of an i.f. pentode (front row) and a 9 w. output pentode (back row). Front row, left to right: AF 7 (1937), EF 9 (1937), EF 22 (1941), EF 41 (1946). Back row: AL 4 (1937), EL 3 (1937), EBL 21 (1941), EL 41 (1947).



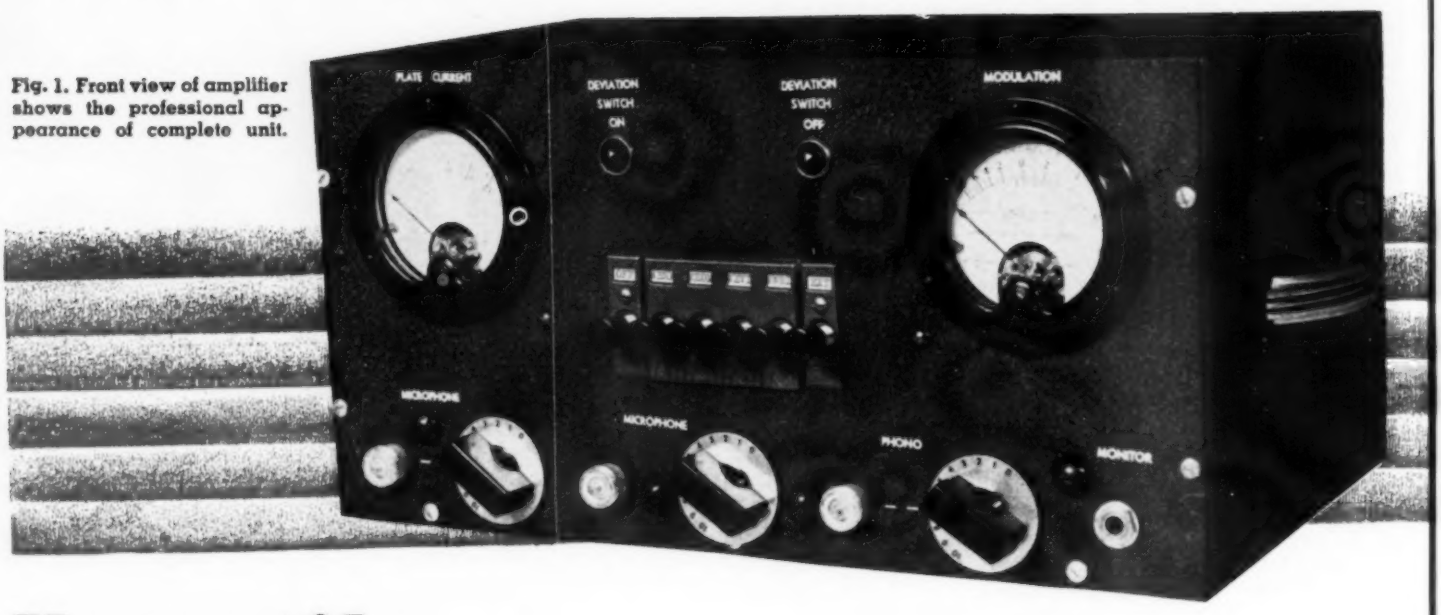


Fig. 1. Front view of amplifier shows the professional appearance of complete unit.

Versatile REMOTE RADIO LINE AMPLIFIER

By PHILIP ROSS

Construction details of a line amplifier having an output of 18 db. with less than ½ of 1% distortion.

THE crystal microphone in commercial broadcasting is quite conspicuous by its absence. Today, crystal microphones ranging in price from 12 to 30 dollars possess too many advantages over the "accepted" velocity and dynamic microphones to negate their use in at least one phase of broadcast operation. That is the remote point pickup. Among the many virtues of the crystal microphone that makes it a natural for remote broadcasts are:

RUGGEDNESS—The crystals can take much more abuse without electrical impairment than the velocity and dynamic types. Simpler and less troublesome is the crystal mike cable which consists of only one shielded conductor as against two wire shielded cables for the velocity and dynamic.

FIDELITY—For remote point pickups, the crystal is indistinguishable from the velocity and dynamic mikes even with extreme cases of 100 foot cables.

HIGH OUTPUT—Together with the crystal's high impedance simplifies the input circuit of the remote amplifier.

EASY REPLACEMENT—Its loss at the last moment is not calamitous because a mike or two can generally be borrowed from some close at hand p.a. system.

Having disposed of the microphone problem there is left the most important, and troublesome, item, the remote amplifier itself. Commercial remote amplifiers and the necessary velocity or dynamic mikes are too costly, particularly for the smaller stations, when it is considered that most remote amplifiers are left at the pickup points for repeat programs. They are also too complex in operation for the many remotes that are manned by non-technical clients. In the event of trouble, such as a defective tube, the broadcast is generally lost.

It is also impossible to selectively feed two or more stations, recording studios or monitoring points simultaneously because of either mechanical or electrical deficiencies in the system.

In an effort to meet these problems of air loss time, ease and confidence of operation, and versatility of program feeding, a remote line amplifier was designed, having many unorthodox features such as:

Push-button selection of any subscribed station, recording or monitoring lines. Amplifier is turned on simultaneously.

Similar feed to different lines by simply pressing the desired buttons together.

Automatic short-circuiting of all unused lines. This prevents cross talk and other extraneous noises from entering the program feed. This feature also permits loop resistance checks of the program lines to be made from station studios and recording offices before actual program time in order to ascertain whether a line is shorted, open or partially blocked. Since each fixed telephone line has a definite loop resistance, any variation of over 10% would indicate trouble which the telephone company can often clear one hour or more before program time.

Elimination of the master gain control and the use of extended fader rotation for smooth fades does away with an additional noise source and operational confusion.

An activated spare tube bank with an emergency toggle switch located on the chassis that substitutes a complete set of tubes in the event of tube noise or failure.

A plate current meter that indicates any abnormalities, such as emission drop-off, excess capacitor leakage, etc., well in advance of actual breakdown.

Parallel element wired tubes, except for the heaters, are used in all stages including the rectifiers (Fig. 3). A toggle switch marked SWITCH ON and SWITCH OFF located on the chassis (Fig. 2) selects the appropriate heater bank which corresponds to

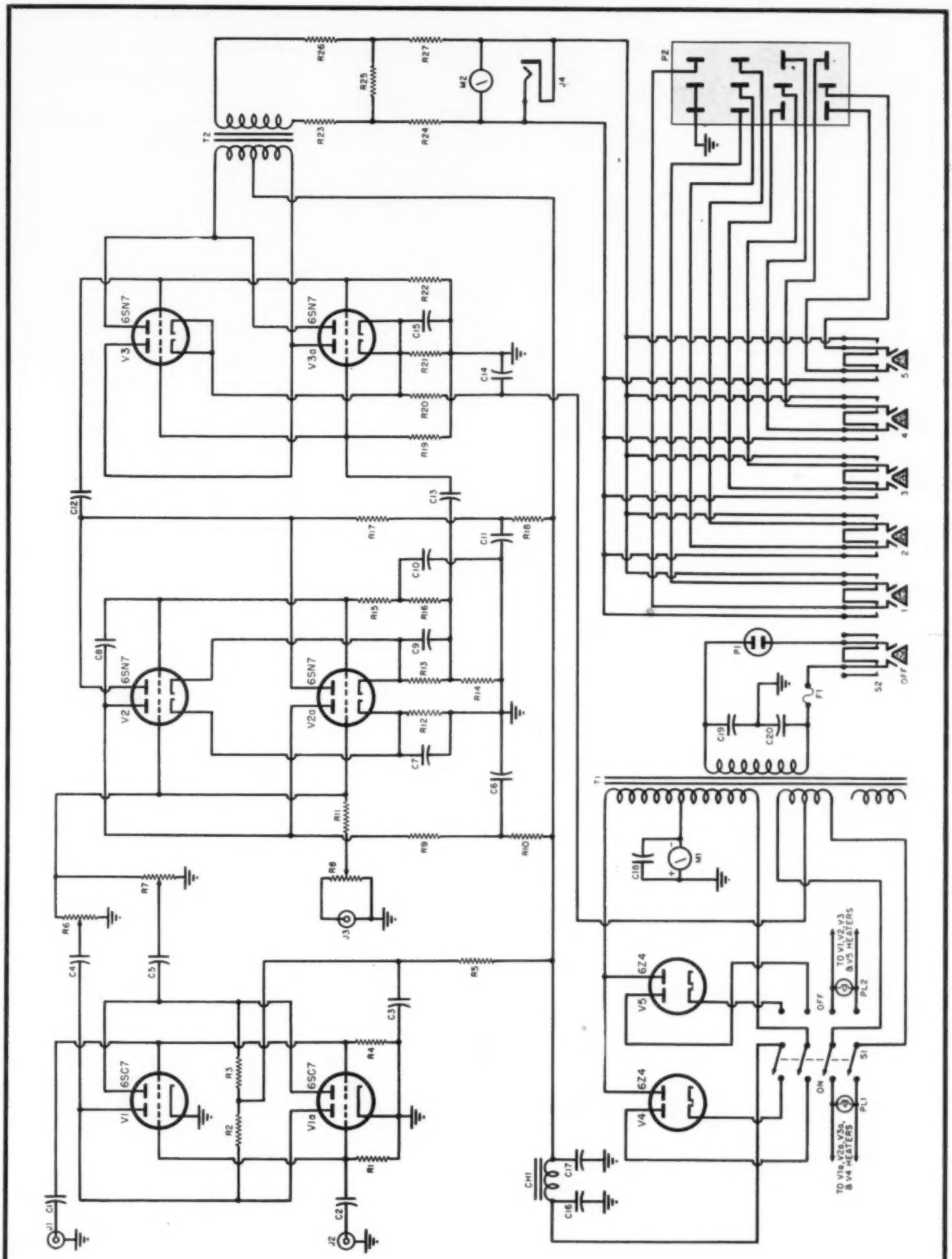


Fig. 3. Complete circuit diagram of amplifier. Parts list is given on next page (p. 14).

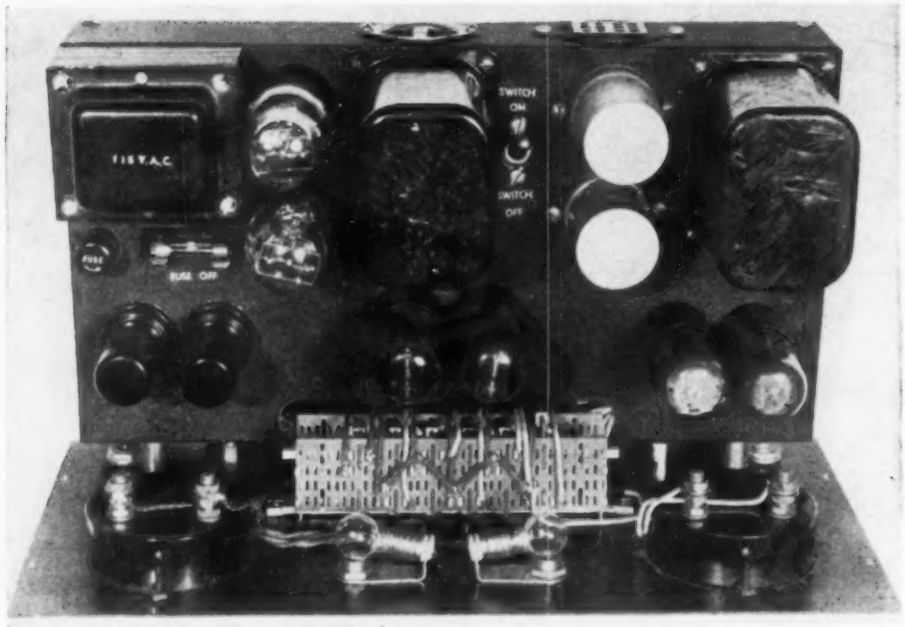


Fig. 2. Top view of amplifier shows placement of parts on top of chassis.

one of the pilot lamps marked DEVIATION SWITCH ON or DEVIATION SWITCH OFF located on the front panel (Fig. 1). Normally, the toggle switch is left at the SWITCH OFF position and the green pilot lamp marked DEVIATION SWITCH OFF is illuminated in operation. In the event of trouble, the switch would be thrown to SWITCH ON and the red pilot lamp marked DEVIATION SWITCH ON would be lighted thus indicating that at an opportune time the tubes in the inoperative bank should be tested.

A six-button selector switch feeds the audio output into 5 designated broadcast, recording or monitoring channels, as selected. Depressing any of these 5 buttons also turns the amplifier on. The sixth button turns the amplifier off. For additional channels, an 8-button selector switch, *Mallory* 2198, should be used.

Total plate current is indicated by the meter at the left in Fig. 1. Normal current is 24 ma. Red pencilled limit marks are drawn on the scale at 15 and 30 ma. At the right under MODULATION is the db. meter, which is a high speed, slow decay type. The MONITOR jack is insulated from the panel with extruded fiber washers.

Fig. 2 also shows the fuse post extractor and a conveniently held spare fuse marked FUSE OFF. The power transformer is at the extreme upper left, the two rectifier tubes alongside, then the filter choke, heater change toggle switch, filter capacitors and output transformer. Toward the front left are the two 6SC7 input tubes, and moving towards the right are the two 6SN7-GT drive-phase inverter tubes and the two 6SN7-GT push-pull output tubes. A.c. line input and audio line output plugs are discernible on the rear apron. The push button switch is in the center of the front panel together with other recognizable parts.

Circuit Analysis

A grid current biased 6SC7 dual triode, V_1, is employed as an electronic mixer. Distortion and hum injection is lower if this mode of operation is used instead of cathode biasing. Mikes are coupled to the grids of V_1 through blocking capacitors C_1 and C_2. The mike inputs, as well as phono, are introduced through closed circuit connectors. This precaution eliminates live grid howls in the event of disconnected mikes and turned-up potentiometers. The 6SC7 plates are terminated in their own plate loads R_2 and R_3 and are fed into paralleled potentiometers R_6 and R_7. For gain and attenuation smoothness the ordinary graphited pot is unsurpassed and can be expected to give many years of noise free operation in this high audio mixing circuit. But for permanency and an occasional contact cleaning, the *Daven* type CP-804-Z can be substituted instead. No master gain control has been found necessary or desirable since the inclusion of one means another possible noise source and greater operating complexity.

The phono pickup is fed into the input triode section of the 6SN7-GT tube, V_2, through an isolating resistor R_{11}. The other triode section of V_2 is employed as a drive-phase-inverter, rendering 6 db. of useful gain and 14 db. of feedback within itself, which provides perfect symmetry of voltage throughout the audio spectrum across the output tube grids of V_3. The purpose of the resistance-capacitance filter R_{16}, C_{10} is to eliminate the a.c. component from the cathode coupling resistor R_{14}.

The push-pull output stage using a 6SN7, V_3, is conventional. This stage is capable of developing an undistorted output directly across the 500 ohm loaded secondary of T_2, at a level of plus 18 db. Contrast this reserve output with a normal single line feed which only requires a peak level of plus 2 db! When two or more lines are bridged across the output the power requirements increase. However, the reserve power output of this push-pull stage is sufficient to feed 3 lines simultaneously at plus 2 db. at ½ of 1 per-cent total harmonic distortion. The 4 db. symmetrical *T* pad interposed between the secondary of T_2 and the feed lines to equalize any reactive effects in the telephone lines and also minimizes impedance mismatches when more than one line is used at one time.

Fig. 3 discloses that on S_2 the buttons 1 through 5 are in the OUT position, therefore the feed channels of these buttons are short-circuited. Depressing any of these buttons opens the respective feed channels and places them across the audio output from T_2.

A cathodic type, 84/6Z4, rectifier is

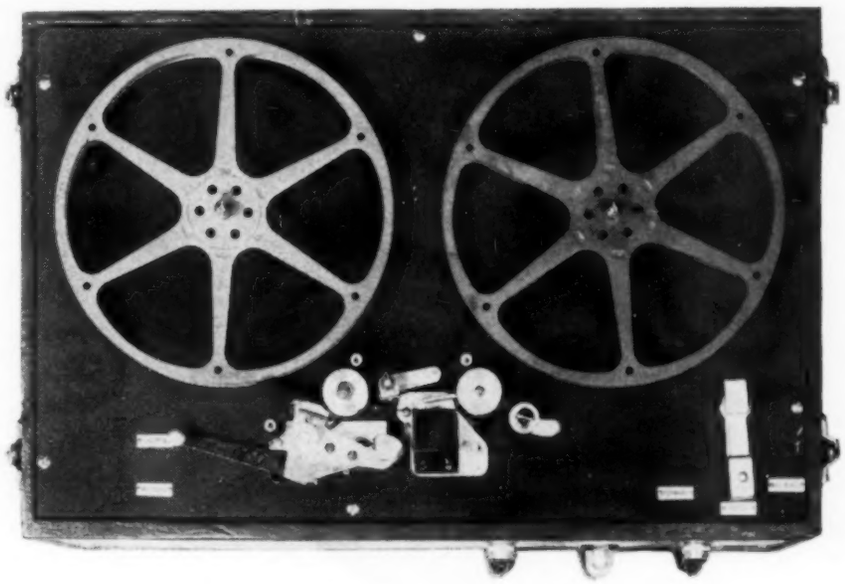
(*Continued on page* 28)

Parts list for amplifier. Circuit diagram is on last page (p. 13).

R_1, R_4—*5.6 megohm, ½ w. res.*
R_2, R_3, R_{19}, R_{20}—*.27 megohm, 1 w. res.*
R_5, R_{30}—*47,000 ohm, 1 w. res.*
R_6, R_7, R_8—*1 megohm pot.*
R_9—*.1 megohm, 1 w. res.*
R_{10}—*22,000 ohm, 1 w. res.*
R_{11}—*1 megohm, ½ w. res.*
R_{12}—*3900 ohm, 1 w. res.*
R_{13}—*1200 ohm, 1 w. res.*
R_{14}, R_{17}, R_{18}—*12,000 ohm, 1 w. res.*
R_{15}, R_{16}—*470,000 ohm, ½ w. res.*
R_{21}—*470 ohm, 2 w. res.*
R_{22}, R_{24}, R_{26}, R_{27}—*56 ohm, ½ w. res.*
R_{28}—*1100 ohm, 1 w. res.*
Instead of R_{22}, R_{24}, R_{25}, R_{26} and R_{27}, a 4 db. 500/500 fixed pad (Daven H-154 or equivalent) may be used
C_1, C_2—*.005 μfd., 300 d.c. w. v. mica cond.*
C_3, C_6, C_{11}—*10 μfd., 450 v. elec. cond.*
C_4, C_5, C_8, C_{12}, C_{13}—*.01 μfd., 600 v. cond.*
C_7, C_9, C_{18}—*20 μfd., 25 v. elec. cond.*
C_{10}, C_{19}, C_{20}—*.05 μfd., 600 v. cond.*
C_{14}—*.1 μfd., 400 v. cond.*
C_{16}, C_{17}—*20 μfd., 450 v. elec. cond.*
S_1—*4 pole double throw sw.*
S_2—*6 or 8 button d.p.d.t. sw., Mallory 2196 or 2198, or equivalent*
T_1—*Power trans., 480 v. c. t. @ 40 ma., 6.3 v.c.t. @ 2 a., 5 v. @ 2 a. (not used)*
T_2—*Output trans., push-pull low level plates to line (15,000 ohms to 500 ohms)*
CH_1—*60 hy., 40 ma. filter choke*
M_1—*0-30 ma. d.c. meter, Weston model 301 or equivalent*
P_1—*A.c. input plug*
P_2—*12 contact socket, Jones S-312-FP; 12 contact male receptacle, Jones P-312-CCT or equivalent*
PL_1—*Green jewel light*
PL_2—*Red jewel light*
These two lights use 12-16 v. candelabra lamps
V_1, V_{1a}—*6SC7 tubes*
V_2, V_{2a}, V_3, V_{3a}—*6SN7-GT tubes*
V_4, V_5—*84/6Z4 tubes*

MAGNETIC PAPER TAPE RECORDER

Top view of portable tape recorder with "head" cover removed to show details of the recording and erasing heads.



***Hyflux*, a paper tape coated with a metallic base magnetic powder, provides a new recording medium.**

MODERN industrial research has taken another step forward in the field of recording techniques with the announcement of a new type of magnetic recording material—a magnetic paper tape. This new tape, developed by *The Indiana Steel Products Co.*, is called *Hyflux*.

During the war Hugh A. Howell, research engineer for *The Indiana Steel Products Co.*, undertook an exhaustive research for new permanent magnet materials. He produced a magnetic material in a highly divided state which possessed surprising permanent magnet properties. Remembering Poulsen's experiment and the later developments in magnet recording, Howell built a trial recorder, tested a paper tape coated with this material in the form of a paint, and found it sufficiently encouraging to warrant further research. Two years of such research and sponsored projects at other research laboratories brought this material to its present perfection and stability. The new magnetic tape was given the name *Hyflux* because of its high magnetic flux.

Specifically, *Hyflux* is a metallic base powder as contrasted with other tape materials which are oxides. Its magnetic properties approach those of well-known grades of Alnico. These properties are apparently due to the unique process of its preparation as much as to its composition. It may be pressed into bars but its immediate and most practical use is that of magnetic sound recording tape. Its high coercive force requires a considerably different technique for recording and erasing, however, than that used with wire and lower coercive force materials. The net result is a more simplified recording mechanism and more assured permanency of the tape.

The advantages of magnetic paper tape as a recording medium lie not only in the inherent advantages of the continuous strip but also in the fact that it is a *paper* tape. As such, it requires very simple equipment for winding and reeling purposes, which not only means ease in handling and usage, but also means less work and less cost for the manufacturer to produce.

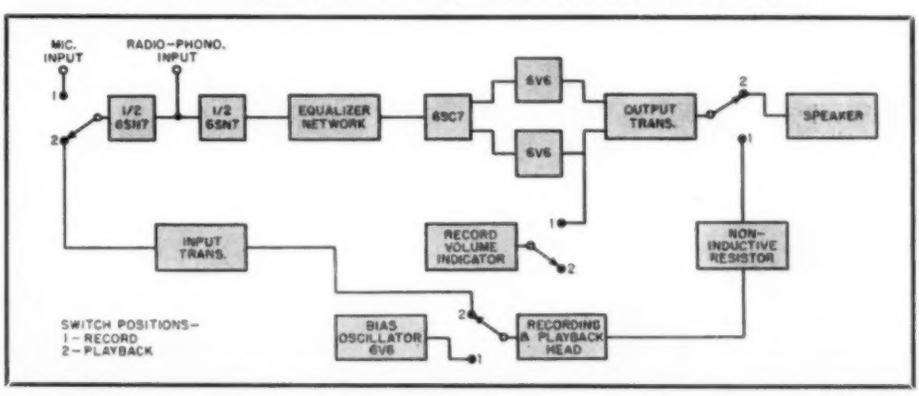
Being paper, it is easily mended when torn, although its six-pound break load insures it against accidental tears. A splice can be easily made, moreover, with Scotch tape, which is an editing advantage as portions of the tape may thus be deliberately cut out.

The paper back side of *Hyflux* magnetic tape also has a number of advantages. For editing purposes again, a particular portion to be cut out can be marked in pencil on the paper side. Or different message contents may be identified in pencil on this paper backing so that a playback at any point is immediately available.

Again, the paper back provides insulation from the successive layers of magnetized tape, thus eliminating cross-talk from the tendency of one magnetic layer to interfere with the magnetic record of touching layers. This is particularly important when the magnetic record is to be a perma-

(*Continued on page* 23)

Fig. 1. Circuit block diagram of self-contained portable magnetic recorder.



MULTIVIBRATORS

Typical multivibrator unit used with frequency-measuring equipment. Oscillations of a 1 mc. crystal are reduced to a 10 kc. standard frequency by subdivision.

By
TOM GOOTEE

A discussion of flip-flop circuits, electronic switches, one-shot multivibrators, and uses for these circuits.

PART I of this two-part article closed with a discussion of various methods of synchronizing multivibrators. Special circuits will be discussed in this final part.

Flip-Flop Circuits

Simplest form of flip-flop multivibrator (Fig. 2) is a trigger circuit employing direct coupling between the plates and grids of the two tubes. It is not an oscillator in the strict sense, but a symmetrical circuit possessing two conditions of stable equilibrium.

Although the two grids are not biased at cutoff, only one tube at a time is allowed to conduct. The circuit remains static—in one or the other of these two conditions—with no change in plate, grid, or cathode voltages or in plate current *until an input control voltage is applied.* This causes the *non*conducting tube to conduct, and stops conduction in the other tube.

The circuit then remains stable until again triggered by the control voltage.

Because of the nature of the sudden change in circuit equilibrium, this arrangement is known as a *flip-flop circuit.* It is also sometimes known as the Eccles-Jordan trigger circuit.

Analyzing its operation (Fig. 2), assume that the multivibrator is balanced; that is, "opposite" circuit elements are about equal in value. However, *perfect* balance is not possible. Thus when supply voltages are applied, a cumulative action takes place. This action commences when one tube conducts more than the other.

Assume that tube V_1 passes a slightly larger current than the second tube, and thus the voltage drop across R_1 is greater than that across R_2. Voltage at the plate of V_2 is greater than that at V_1. When the voltage at the plate of V_1 is applied through R_3 to the grid of V_2, it forces a further decrease in current through the second triode—causing an increase in voltage at the plate of V_2. This voltage increase is applied to the grid of V_1 through R_4, causing V_1 to conduct more heavily.

Cumulative action continues until tube V_1 is conducting continuously at maximum and tube V_2 is cut off. In such condition the circuit is in one of its two stable conditions, and is ready for triggering.

This is accomplished (Fig. 2) by a positive-going pulse applied simultaneously to the grids of both triodes. Since V_1 is already conducting heavily, the control voltage will not influence the operation of this tube. However, the second triode is cut off; and if the positive-going pulse is of sufficient amplitude, it momentarily removes the high grid bias on tube V_2. This tube conducts, the voltage at the plate decreases, and this change is applied to the grid of V_1. Current through the plate resistor R_1 decreases, and the resultant rise in plate voltage is applied to the grid of V_2 causing a further increase in conduction.

Cumulative action continues until tube V_1 is cut off and V_2 is conducting at maximum. This establishes the *second* condition of stable equilibrium.

The application of a positive-going pulse—at any time—causes the *non*-conducting tube to conduct, thus reversing the multivibrator circuit from one state of equilibrium to the other. The procedure of reversal is the same for either the first or second triode.

Resistors R_5 and R_6 (Fig. 2) do not affect the triggering action, but their values will influence the shape of the output wave. When the latter is unimportant, the value of these two resistors may be quite large in order to reduce the flow of grid current. Resistors R_7 and R_8 are selected so that the two triodes are biased near cutoff. Resistors R_3 and R_4 are sometimes shunted by small condensers—to provide a time constant large compared to the duration of the input trigger pulse but small compared to the time interval between pulses.

The same multivibrator (Fig. 2) may be triggered by a *negative* going input pulse, and circuit action is somewhat similar.

However, negative-going pulses affect only the tube that is conducting and do not influence the tube that is cut off. Such input pulses cause a sudden decrease in plate current and a corresponding rise in voltage at the plate of the triode that is conducting. And when this voltage is applied to the cut off tube, conduction begins and the usual multivibrator switch action is initiated.

For every input control pulse of proper amplitude, the flip-flop circuit executes one alternation. But *two* input pulses are necessary for a *complete* cycle of operation.

Other variations of the flip-flop circuit are possible. Pentodes may be used, by coupling the suppressor grids to the plates of the tubes. Input control pulses may be applied to the suppressor in place of the control grid, by supplying the screens with independent voltages.

Most flip-flop multivibrators have one unfortunate limitation: they will not "flip" satisfactorily immediately after they have "flopped"—thus restricting the highest frequency of operation. This limitation is characteristic; because even though the circuit is in a stable condition after an initial alternation, the grid condensers often require a certain time to return to their normal state of charge.

One-Shot Multivibrators

Modification of the previous arrangement provides a circuit which accomplishes a *complete* cycle of operation each time a control pulse is applied. Commonly called a *one-shot multivibrator*, it is also known as a single-cycle or single-stroke multivibrator, and a Kipp relay.

The basic circuit (Fig. 1A) is essentially a two-stage resistance-capacitance-coupled amplifier with one tube cut off and the other normally conducting. A condition of balance is maintained by the amount of biasing on the two triodes. Resistor R_2 connects the grid of V_2 with the cathode of the tube. Normally there is no current flow through R_2. Therefore the grid bias on the second tube is normally zero.

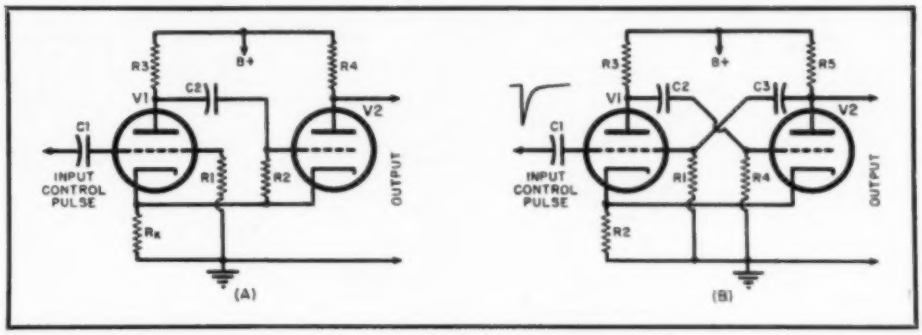


Fig. 1. (A) Basic one-shot multivibrator. (B) One-shot multivibrator with positive grid return.

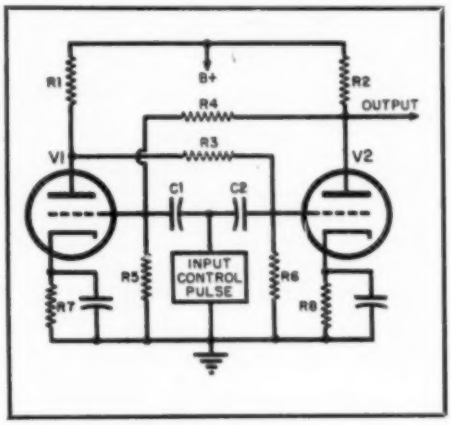


Fig. 2. Flip-flop multivibrator.

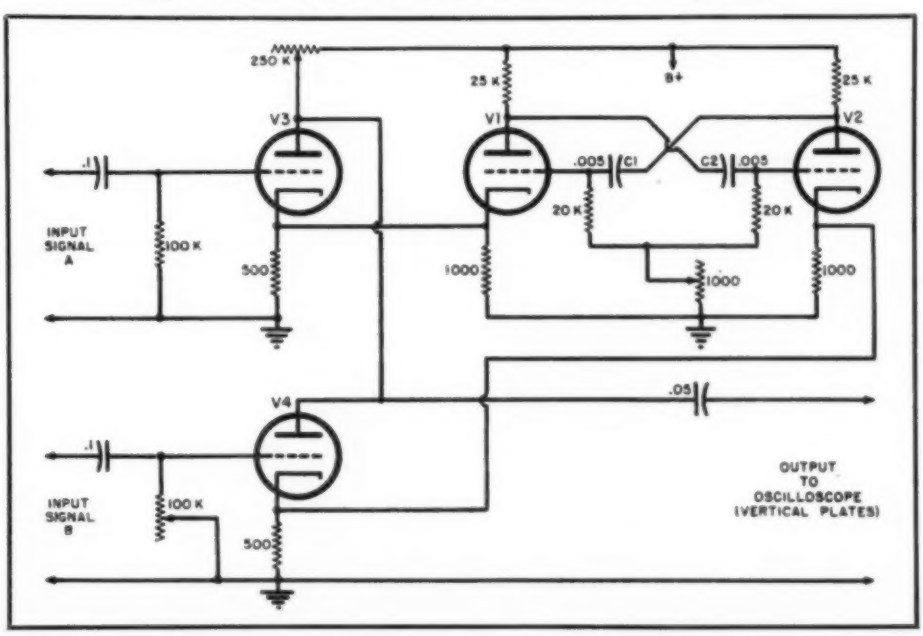
Two important circuit conditions should be kept in mind. When tube V_2 is conducting, plate current flows through the cathode resistor R_k and biases the first tube beyond cutoff. When tube V_2 is *not* conducting, the first tube cannot be cut off by the small amount of self-bias developed across resistor R_k.

A positive-going input pulse is required to operate the circuit (Fig. 1A). Its action is shown graphically by the waveforms in Fig. 5.

Assume that tube V_1 is cut off and tube V_2 is conducting heavily, when a positive-going pulse is applied to the multivibrator. The pulse is coupled via C_1 to the grid of V_1 and is of sufficient amplitude to raise the grid of the tube *above* cutoff. When V_1 conducts, the voltage at its plate decreases. Since the voltage across a condenser cannot be changed instantaneously, this voltage decrease is applied through C_2 to the grid of the second tube. Tube V_2 conducts less heavily, lowering the voltage drop across resistor R_k. As more current flows in V_1, less current flows in V_2. The process continuous until V_2 is cut off and the first tube is conducting at maximum.

By this time the condenser C_2 has discharged sufficiently to allow the grid of V_2 to rise from its lowest value

Fig. 3. Electronic switch utilizing a multivibrator in its operation.



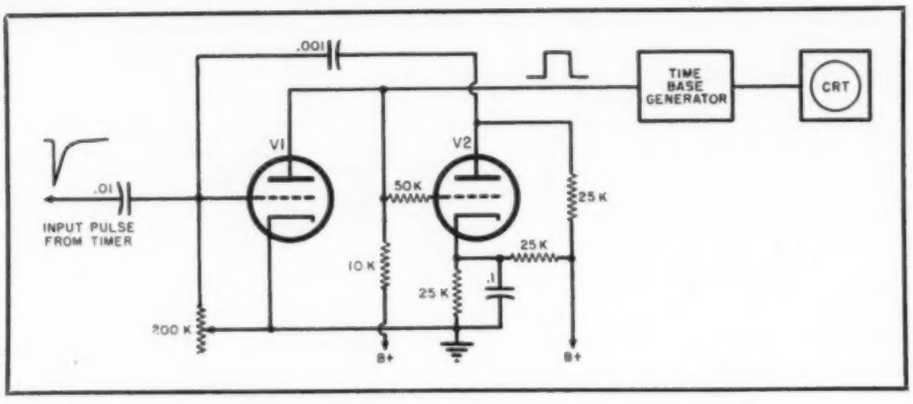


Fig. 4. One-shot multivibrator used to trigger a sweep generator.

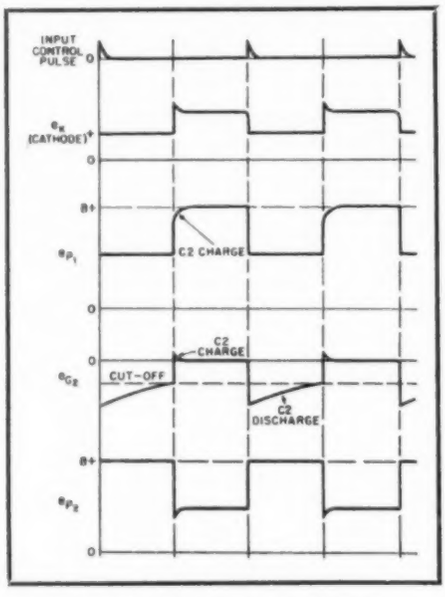


Fig. 5. Waveforms for basic one-shot multivibrator (Fig. 1A).

to about cutoff voltage. Then V_2 begins to conduct, and current flowing through R_k causes a decrease in the conduction of tube V_1. This, in turn, is coupled to the grid of V_2 permitting a further increase in the plate current in V_2. The action is cumulative until tube V_1 is cut off and V_2 is conducting heavily.

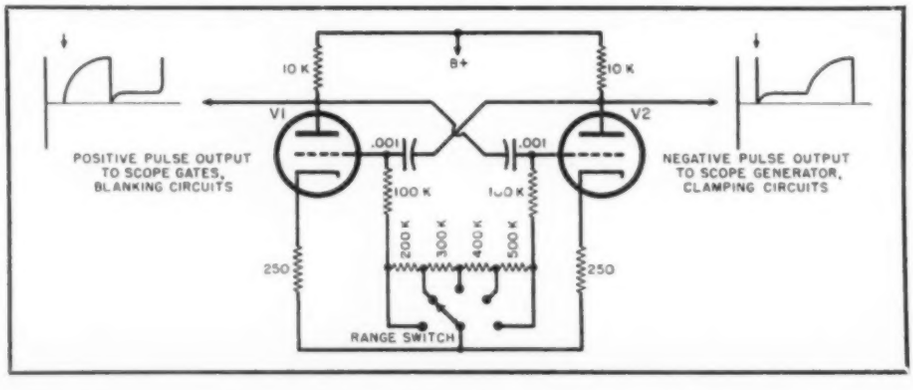
The circuit has thus been returned to its initial state, and it will remain so until another positive-going input pulse permits a repeat operation. A complete output cycle is produced for *each* input pulse, regardless of how frequently this pulse is applied.

When the output of this circuit is taken from the plate of the second triode V_2, the waveform is a positive-going pulse of high amplitude. The length and shape of the output pulse is controlled largely by the *time constant* R_2C_2 (Fig. 1A).

A slight variation of this circuit can be used for *negative*-going input control pulses. In the new circuit (Fig. 1B), the grid of the first tube is connected to a positive potential instead —as previously—to the cathode. When not being triggered, the first tube is conducting—since the grid of V_1 is slightly positive with respect to the cathode. The second tube is cut off, because of the bias developed across R_2 by the current flow due to conduction in V_1. The grid of the first tube is only slightly positive, since the voltage drop across R_1 is approximately equal to the plate voltage.

Application of a negative-going pulse decreases the plate current of V_1 and increases the voltage at the plate. This latter voltage is coupled to the grid of V_2 via condenser C_2. As plate current flows in the second tube, the corresponding decrease in plate voltage is coupled through C_3 to the grid of V_1. A further increase in plate potential at the first tube is again impressed on the grid of V_2. The action continues until the first tube is cut off and V_2 is conducting heavily.

Fig. 6. Multivibrator used as a master oscillator.



When the discharge of condenser C_3 fails to maintain a sufficiently negative potential on the grid of V_1, the tube conducts and the voltage at its plate decreases. This is passed to the grid of the second tube, and its plate current decreases—causing its plate potential to rise. When this rise is impressed on the grid of V_1, the flow of plate current in V_1 is further increased. The action continues until V_1 is conducting heavily and V_2 is cut off, when the circuit is returned to its original quiescent state.

Another variation of the one-shot multivibrator is a circuit (very similar to that of Fig. 1B) using pentodes with d.c. coupling, the plates of the tubes being coupled directly to the screen grids. Sharp cutoff tubes are employed, and the circuit provides extremely rapid triggering for high-speed operation.

It is extremely desirable to use control pulses of short duration compared to the "natural" frequency of multivibrator oscillation, because the input control pulses serve to bring the electrode potential to a point which, if maintained, would transform the circuit into a continuous or free-running multivibrator.

The coupling condenser injecting the control pulses should be as small as possible, to minimize loading of the multivibrator by the triggering circuit.

Electronic Switching

Sharply defined rectangular output waves of a symmetrical multivibrator find wide use as a means of switching connections rapidly and continuously.

One circuit impresses two signals *alternately* on the same pair of deflecting plates of a cathode-ray tube, providing double-wave observation. While not actually on the oscilloscope screen simultaneously, the two signals appear so to the human eye.

This switching arrangement (Fig. 3) provides a means for comparison of the strength of two signals received from two antennas, two circuits, or from two points in the same circuit. Phase relationships between two signals may also be observed with this arrangement, whose operation is controlled by a balanced free-running multivibrator. (See Fig. 3.)

The two input voltages to be observed are applied separately to each of two triode amplifiers. The plates of these tubes are then joined and connected through a condenser to one pair of plates of a cathode-ray tube. With both triodes functioning as straight amplifiers, both signal *A* and signal *B* would appear simultaneously in the output—an undesirable condition, since the signals would react unfavorably upon each other. Sum

and difference voltages, and other effects, would cause serious picture distortion on the screen of the tube.

Input signals *A* and *B* must be applied *alternately*. This can be accomplished by a conventional, basic multivibrator—which provides two switching voltages to bias *alternately* the amplifier tubes V_3 and V_4 in and out of operation.

Such suitable potentials—of sufficient amplitude, but differing in phase by 180 degrees—are obtained from the cathodes of the multivibrator tubes V_1 and V_2. These shift voltages are applied to the cathodes of the two amplifier tubes V_3 and V_4, respectively.

The two amplifier tubes are biased in such a way that the effect of the shift voltage is to alternately raise and lower the grid bias of each tube above and below cutoff. Thus the amplifier triodes are allowed to function alternately, but never together at the same time.

If desired for greater stability, the free-running multivibrator may be synchronized by either input signal merely by injecting that signal into either grid circuit of the multivibrator.

As an electronic switch, the multivibrator may feed two antennas alternately from one transmitter, or a single receiver from two separate antennas.

General Use

Ability of the multivibrator to produce nonsinusoidal oscillations of almost any shape, makes it useful in many types of electronic applications —particularly those requiring rectangular waves and pulse forms.

As a square-wave generator, the multivibrator is widely used in testing apparatus, and as a primary source of peaked waves and pulses of short duration. Often a single multivibrator can replace as many as six or seven stages of a pulse-shaping circuit. And it is an excellent source of saw-tooth voltage or current waves for operating cathode-ray oscilloscopes.

Often it is used to introduce a circuit time delay between the operation of two related stages of an electronic device: by using the leading edge of the output wave to trigger one part of the circuit, and using the trailing edge to trigger another part or other stages.

A system of checking receiver sensitivity with a multivibrator was described in the July 1944 issue of RADIO NEWS.

As a means of accurate frequency division or multiplication, the merits of the multivibrator have been previously described.

A typical one-shot multivibrator

(*Continued on page* 27)

Personals

LEON ALPERT has purchased a 50 per-cent interest in the *Eastern Amplifier Corp.*, 794 E. 140th St., New York, and has assumed complete supervision and control of general management of the company. Included in his plans for *Eastern* is expansion of products and sales in the sound systems field. Detailed arrangements are under-way for the setting up of a national sales network. In addition, an export division has been established.

WILLIAM F. COTTER has been selected as chief engineer for *Scott Radio Laboratories, Inc.*, Chicago. During his 29 years in radio engineering, Mr. Cotter has aided in the development of point-to-point duplex telephones, ship-to-shore telephone systems, police radio systems and home broadcast receivers. Chief radio engineer and later radio consulting engineer for *Stromberg-Carlson* since 1935, he pioneered much work on FM broadcasting.

DR. GEORGE C. KUCZYNSKI is doing basic research work in studies of the electron theory of metals in his new post on the research staff of *Sylvania Electric* Metallurgical Laboratory. He was previously a special instructor at M.I.T. The 1945-46 recipient of the Baldwin-Southwark Fellowship Award for fundamental work on strain gauge wires, Dr. Kuczynski formerly taught at the University of Cracow and in Britain's V12 war training program.

DR. LADISLAUS L. MARTON recently joined the staff of the National Bureau of Standards as principal physicist in the electronics section. He will initiate a program of research on the basic theory, methods and applications of electron and ion beam devices. Internationally known for his work in electron optics, particularly in the development of the electron microscope, Dr. Marton previously was associate professor of physics at Stanford University.

THOMAS B. MOSELEY of Dallas was recently named a broadcast sales engineer in the southwest area for *Collins Radio Co.* He has been active in radio work since 1933. Formerly associated with the *Weldon Engineering Co.* of Del Rio, Tex., Mr. Moseley was chief radio engineer, Signal Office, Headquarters Eighth Service Command, during the war. More recently he served as secretary-treasurer and chief engineer for *International Electronics Corp.*, Dallas.

DR. CHARLES M. SLACK was recently appointed director of research for *Westinghouse* Lamp Division. Dr. Slack, who developed an electronic tube making possible millionth-of-a-second x-ray exposures, joined the research department as a physicist in 1927 and became assistant director of research in 1943. His x-ray tube was used in the atomic bomb experiments and for ballistic studies at U.S. and British arsenals and proving grounds in the war.

Industrial Review

New Hexacon Plant

A new factory, adjoining the old plant, has been completed for *Hexacon Electric Co.*, Roselle Park, N. J.

Addition of the 7000 sq. ft. to house

increased facilities became necessary to meet the record demand for *Hexacon* industrial soldering irons. Improved lighting and better arrangement of assembly operations are among the features of the new plant.

General offices will continue to be located at 213 West Clay Ave., Roselle Park, N. J.

* * *

New Medical Weapon

Introduction of radioactive isotopes, by-products of the atomic bomb, into the human system and the following of their course by means of a Geiger counter have given medical science a powerful new weapon with which to fight diseases, making it possible to confine studies to a particular organ or body section.

Demonstrated on a standard x-ray table at the *North American Philips*

Co., N. Y., the accompanying picture shows a patient about to be checked with a Geiger counter.

* * *

Silicones

Already known to be effective as a high-temperature varnish for motor windings, silicones are constantly being found to be successful in uses with many types of electrical apparatus.

Though the costs of silicone varnishes still preclude their wholesale use on rotating machines, they are being tested on railway motors, enclosed industrial motors, magnet coils and for transformers used in streetlight fixtures.

Silicone rubber or gasketing material has proved useful as a cover seal for searchlights where the temperatures created by the electric arc become exceedingly high.

Westinghouse Electric Corp., Pittsburgh 30, will supply additional information on request.

* * *

Aluminum in Voice Coils

Aluminum foil bases are being used instead of paper bases for voice coils

in the manufacture of *General Electric* loudspeakers.

Engineers of the specialty division of the company's Electronics Department say aluminum offers five advantages. These include ability to handle higher wattages, resistance to the effects of temperature and humidity, longer life, elimination of the possibility of warping or cracking, and better control on gaps.

* * *

Given American Rights

The *Aluminum Solder Corp.*, 10 E. 52nd St., N. Y., has been given exclusive manufacturing and distribution rights in North and South America for a new and highly effective aluminum solder, called Prolyt, by *Handex AG* of Zurich, Switzerland.

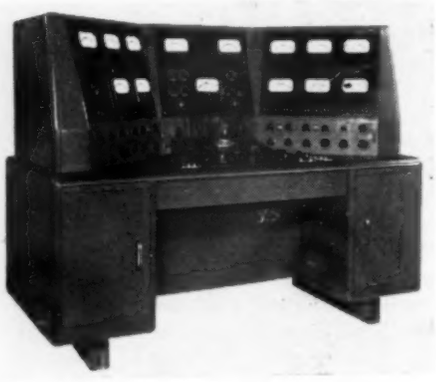
Prolyt, which uses no flux or flux substitute, was developed for *Handex AG* during the war to permit a wider use of aluminum and copper which are not scarce in Switzerland.

With the new material sheet aluminum, electrical wiring or any other aluminum equipment can be soldered with greater simplicity and with far less danger of corrosive agents weakening or marring the joints.

* * *

Vacuum Tube Test Set

Reduction of operator fatigue and elimination of personal errors resulting from circuit arrangement have been accounted for in the design of a



vacuum tube bridge characteristic test set announced by *Sylvania Electric Products, Inc.*, Electronics Division, 500 Fifth Ave., New York 18, N.Y.

The console unit includes bridge and auxiliary switch gear mounted on the control shelf; electronically regulated power channels; bridge signal source; amplifier; meters, and other accessories. All meters except those for gas and heater cathode current are located on sloping panels.

* * *

Spectrumanalyser

A laboratory technician at the *Polytechnic Institute of Brooklyn* calibrates a general purpose laboratory attenuator against one of the precision standards built by the *Polytech-*

nic group. She is checking the adjustment of the precision standard by a spectrumanalyser.

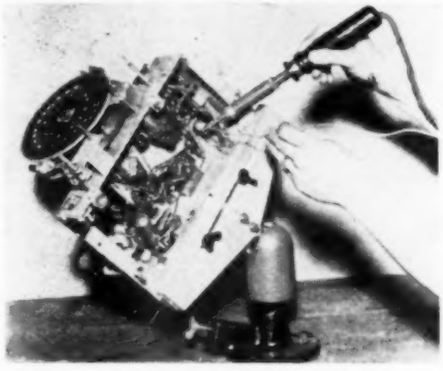
* * *

Work Positioner

Most types of benchwork can be held and positioned more quickly and easily by the Powrarm Universal positioner being produced by the *Garfield Engineering Corp.* of Kansas City, Mo.

Both hydraulic and mechanical models of the Powrarm are made. In ad-

dition to increasing efficiency and productivity of the worker by permit-



ting him to work with both hands free, the device conserves his energy and reduces hazard of injury and damage to the equipment.

Electronic Clock

(*Continued from page* 9)

groups of five cycles of 1000-cycle frequency spaced 1/200th second apart. During the time when no signal is being passed by the amplifier, the seconds contact is closed and it is opened during the next no signal period. Therefore, the seconds pulse consists of five cycles of 1000-cycle frequency given once each second, supplying a seconds pulse 1/200th second long.

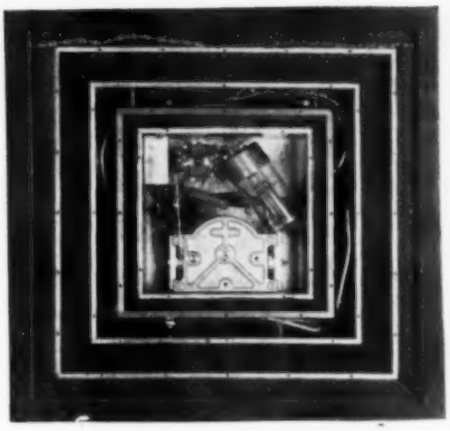
The absolute accuracy of the frequency of the crystal oscillator is at present within a few parts in one hundred million. Although the seconds pulses are obtained by exact division of the quartz plate frequency, due to possible phase shifts and other difficulties, the pulses are accurate to one part in one million. In other words, the length of a one second interval as broadcast is accurate to one microsecond. An interval of one minute or longer is accurate to a few parts in one hundred million.

However, to supply an accurate time interval is one thing; to supply a time signal with a high absolute accuracy is quite another. The Bureau depends upon the Naval Observatory to supply the absolute time and differences between this and the time signals broadcast from the Bureau's radio station WWV at Beltsville, Maryland. As these differences are based upon data obtained both before and after a radio time signal has been transmitted, it is necessary to extrapolate continually the data from a known correct value two or more weeks in the past. For this reason there are days when the error to the absolute value of the broadcast time may be as great as 0.02 second.

In addition to the continuous accurate time intervals and announcements, the broadcast by radio station WWV provides standard radio frequencies, standard audio frequencies (440 and 4000 cycles per second), the standard musical pitch (A above middle C), and radio propagation disturbance warning notices.

The quartz crystal of the clock is cut to a certain size and at an angle to the axis of the mother crystal to give the desired frequency and temperature coefficient. Each clock also has a driver circuit arrangement and frequency dividing equipment. The rate of the crystal clock depends on the temperature, pressure, and humidity of the air around the quartz plate, and the operating voltage of the circuit supplying the frequency—conditions which necessitate very accurate control. Pressure and humidity are maintained by sealing the quartz plate in a glass or metal enclosure while the temperature is held constant by placing the quartz plate and certain important parts of the circuit arrangement in a constant-temperature oven.

There are many peacetime uses for frequency and time services other than checking the operation of clocks and other time pieces. The accurate measurement of time is of importance in seismology, geodesy, and navigation, in other countries as well as our own. The broadcasts are being utilized by many organizations such as schools and universities, scientific laboratories, manufacturers, and users of radio communications equipment; observatories which are widely-separated and make automatic recordings of astronomical phenomena and motions of earth; power companies which continuously check the frequency of power generated at widely separated stations; communications companies which regularly transmit photographs by wire or radio; and certain radio broadcast companies which synchronize program features from various countries.

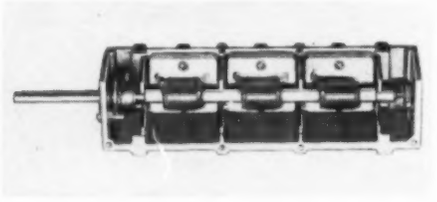


Interior view of 100 kc. oscillator.

NEW PRODUCTS

"INDUCTUNER"

With applications in FM and television receivers, amateur and commercial communication receivers, high



frequency generators, and electronic measuring instruments, the "Inductuner" is now being produced by *P. R. Mallory and Co., Inc.*

A patented exclusive *Mallory* development, the "Inductuner" provides infinitely variable inductance tuning for all television, FM and other stations from 44 to 216 mc. within the range of the receiver.

Accredited manufacturers and engineers may write to the *Mallory* company at 3029 E. Washington St., Indianapolis 6, Ind., for a new complete technical information bulletin.

ELECTROLYTIC CAPACITORS

All Type DH "Universal Replacement" dry electrolytic capacitors,

made by *Solar Mfg. Corp.*, 285 Madison Ave., N. Y., now feature a new easy-mounting stud-disk and plate mounting device.

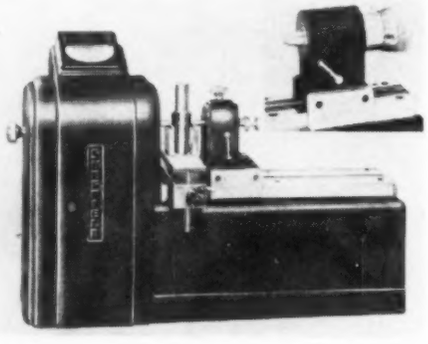
The exclusive *Solar* design permits secure clamping of the capacitor to set chassis in a vertical position when Type DH units are used to replace old screw-base or twist-prong electrolytics. For flat under-chassis mounting, the stud-disk is easily removable by bending two tabs. Capacitors may then be fastened by a universal mounting strap which is packaged with each capacitor.

HORIZONTAL COMPARATOR

The Sheffield Corp. of Dayton, O., has announced a new horizontal external comparator for inspection and gauge laboratory use.

A wide range of adjustability, to 3½ in. in height and to 10½ in. in length, permits quick, accurate measurement of rectangular, threaded or cylindrical parts, tapered or straight.

Readings in millionths of an inch may be obtained from the Sheffield Electrigage head, which is available in amplifications of 100-1, 2500-1 or 5000-1. Other features are an adjust-

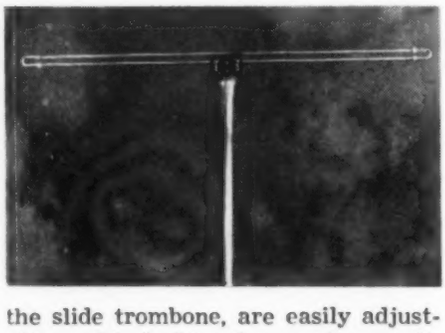


able pressure attachment, elevating table and the choice of a standard or micrometer tailstock with a large, easily calibrated barrel.

FM DYNATENNA

The DynaTenna, a new external dipole FM antenna able to be peaked to the particular frequency of any individual station for maximum response, still maintaining practically flat overall response throughout both bands, has been brought out by *Stromberg-Carlson Co.*

The "U" tube sections of the DynaTenna, designed on the principle of

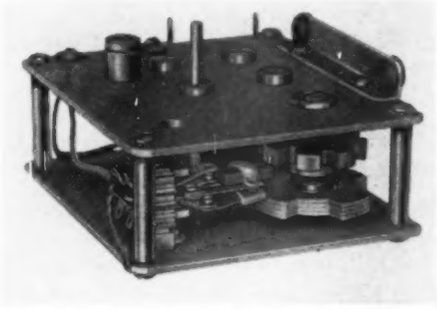


the slide trombone, are easily adjustable and locked in place, and are calibrated in frequency graduations on both sides. The upper side, functioning as a quarter-wave folded dipole, covers the lower frequencies in the 44 to 50 mc. band, while the lower side operates as a half-wave folded dipole in the higher frequencies of the 88 to 108 mc. band.

DynaTenna's flexible construction permits vertical as well as horizontal polarization to accommodate many of the new FM stations now using vertically polarized transmitting antennae.

CONSTANT SPEED D.C. MOTOR

Reportedly the only motor of its kind providing a.c. motor perform-



ance to the d.c. market, an improved model of the Constant Speed D. C. Motor has been developed by the *Amglo Corp.*

The new motor is adapted to many uses heretofore beyond the scope of the d.c. field, particularly in industrial and commercial applications where synchronous units are required. It utilizes the principle of polarized magnetic drive of a vibrating reed, with a resulting powerful attraction and repulsion force which assures immediate self-starting at all times.

Complete information may be obtained from *Amglo Corp.*, 4234 Lincoln Ave., Chicago 18, Ill.

VACUUM CONDENSER

First of a new line of vacuum condensers, the RC100-20, has been in-

troduced by *Raytheon Mfg. Co.*

Raytheon vacuum condensers have overcome the inability of present day vacuum condensers to handle high voltage and high current requirements simultaneously, as well as their serious mechanical resonances.

In addition to their compactness, low loss, low temperature coefficient, and immunity to humidity, dust and other contamination, the new condensers have several features which contrib-

(*Continued on page* 26)

Magnetic Tape

(*Continued from page* 15)

nent one and subject to long storage under widely varying conditions of temperature, humidity, etc.

As for the lasting qualities of the paper itself, the achievements of American paper manufacturers in producing a strong, durable product is assurance enough. For all practical purposes, *Hyflux* magnetic paper tape, both as to its magnetic capacity and its durability, is impervious to the ravages of normal wear and tear.

The recording advantages of *Hyflux* tape are attained by coordinating its inherent magnetic capacity with the specially designed recording head and associated circuits which utilize its high coercive force to maintain a high signal-to-noise ratio. By using higher tape speeds, very high fidelity can be reached at extreme frequencies which would include the third harmonics. This, however, is not considered the normal operational range of *Hyflux* tape because of the sacrifice in recording time to achieve such extremely high fidelities. The frequencies best suited for music are from 100 to 5,000 cycles, but experiments have proved that most people, unless their ears are educated to appreciate the higher ranges, prefer those at the lower end of the scale. This is why the tone control on most radios is kept turned to "bass."

At this time, *Hyflux* will operate satisfactorily for most recording purposes at frequencies up to 6,000 cycles with a tape speed of 8 inches per second. While further development may permit a wider frequency range or lower tape speed, this is considered adequate for home and commercial needs.

Specifications of *Hyflux* tape as applied to its tape recorder use are as follows:

(1) Composition—metallic powder coated on paper tape.

(2) Tape dimensions—width ¼ in.; Thickness—0.002 in. (including coating thickness of 0.0005 in.).

(3) Break load of tape—6 pounds.

(4) Excellent dimensional stability due to choice of paper base; superior to any plastic ribbon available at this time.

Because no existing recorders were capable of utilizing the high coercive force of *Hyflux* tape, it was necessary to develop a new tape recorder which would not only best utilize this material, but would also be simple to operate, economical to manufacture, and would also be within reach of the average consumer.

The resulting tape recorder is the combined work of *The Indiana Steel Products Co.* and the Physics Research Division of the *Midwest Research Institute.* It is the integrated result of research in magnetics, electronics, mechanics and acoustics, as well as experienced practical engineering directed toward making the unit simple to operate and economical to build.

The one fundamental advantage of magnetic paper tape recording over all other systems of recording is the extreme ease with which precision editing can be done. This makes paper tape recording particularly valuable for broadcast use. The paper back side of the tape provides an ideal surface for making notations and for marking the exact point for editing. With editing determined in the initial playback, the tape can be cut at the indicated points, spliced together with scotch tape and then used as a master recording for the production of any number of working copies that might be needed in a broadcast system.

Editing is so precise that a single word or single musical note may be deleted. And the high frequency response, freedom from distortion and background noise of *Hyflux* magnetic tape recording are equal to or better than the best system of recording now in use.

The use of *Hyflux* tape and magnetic recording need not be confined to the acoustical field. Wherever phenomena can be translated into magnetic variations, this magnetic tape can be used to inscribe such data for future study or reference, whether the data be for temporary or permanent usage.

New possibilities in the field of scientific recording machines of all types are also opened up through this new magnetic recording medium. *Hyflux* would provide not only an accurate recording but a permanent one as well, or if permanency were not required, its erasing advantages might be utilized.

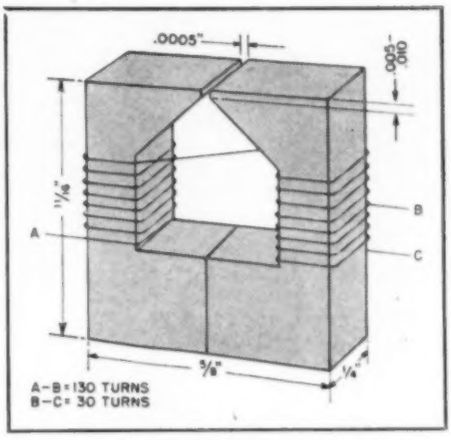


Fig. 2. Record-reproduce head.

NEWS BRIEFS

I.R.E. NATIONAL CONVENTION

What promises to be one of the most consequential national conventions in the history of the Institute of Radio Engineers will be held in New York March 3-6, inclusive. Over 150 manufacturers are slated to exhibit their products at the Grand Central Palace, and a total of 120 technical papers will be read at five different meeting places, three in the Hotel Commodore and two in the Grand Central Palace.

Technical papers have been divided into a number of different basic classifications, such as television, FM, aids to navigation, nuclear physics, instrumentation, electronic controls, basic research and others, covering the whole field of electronics.

Dr. James E. Shepherd is convention chairman, while Dorman D. Israel is in charge of exhibits requirements, and William C. Copp is exhibits manager.

MARINE RADAR AGREEMENT

A broad agreement has been announced between *Westinghouse Electric Corp.*, for the manufacture of marine radar equipment, and the *Tropical Radio Service Corp.*, for the installing, licensing, servicing and selling of the radar units.

The arrangement was reached because of increased demands of world shipping interests for the war development as a navigational and protective aid for maritime vessels. The first *Westinghouse* equipment to be supplied to *Tropical* will be of the continuous plan position indicator type.

Tropical, a wholly-owned subsidiary of the *United Fruit Co.*, was incorporated in 1942 to make specialized radio service available to all merchant shipping.

ENGINEERS HONORED

Two *Bendix* engineers, E. K. Foster and A. E. Abel, have received highest civilian honors, in the form of special commendations for service, from the War Department for their outstanding achievement in the development of radar during the war.

Mr. Foster, factory manager, and Mr. Abel, chief engineer, of the Radio Division of *Bendix Aviation Corp.*, were engaged in the development, research and production of radio set SCR-598, part of the gun-laying radar equipment known as AN/MPG-1. This type of radar made possible accurate and speedy aiming of large guns in sea warfare and harbor defense.

A peace-time application of the unit is in establishment of precise harbor traffic control. Harbor radar installations are described by *Bendix* as expensive, but economical when all-weather safety is needed, as well as speed and efficiency in large scale harbor operations.

NEW VIDEO STATION

Construction of a foundation and towerbase for WOR's television station in Washington, D. C., is under way. Call letters of the new video station of the *Bamberger Broadcasting Service* will be WWBR.

The 300-foot tower will be erected at 40th and Brandywine Sts., the highest point in the District of Columbia, 412 feet above sea level. The top of the television antenna will have an over-all height of 700 feet above sea level.

The tower will hold platforms for short wave, microwave and television receiving and transmitting equipment.

TELEVISION IN INDUSTRY

The Utiliscope, a sight-transmitting system described as the first successful use of television in industry, has been developed jointly by the *Farnsworth Television and Radio Corp.* of Fort Wayne, Ind., and the *Diamond Power Specialty Corp.* of Detroit.

Expected to play an important part in increasing efficiency and safety in industry, the Utiliscope has been in operation the past nine months at *Consolidated Edison's* huge Hell Gate Station Power Plant in New York. There it is used to show the water level in a boiler 325 feet from the main control room and separated from it by eight floors, a building wall and other obstructions.

Further information may be obtained from *Farnsworth*.

FACSIMILE ADVANCEMENT

A patent on a spring loaded, self-compensating printer bar for use in facsimile recorders has been awarded to William G. H. Finch, president of *Finch Telecommunications Inc.*, manufacturers of numerous facsimile devices.

The new instrument employs a rotating helical contact to distribute the received facsimile signal to the appropriate portions of the sensitized paper. The spring arrangement assures uniform recording pressure at all points and also makes the blade self-adjusting for wear of both blade and helical contact.

The printer bar was granted U. S. Patent No. 2,413,962.

RESISTANCE WELDING

For outstanding papers on resistance welding, with significant information on theory and practice included, the Resistance Welder Manufacturer's Association will award cash prizes totaling $2000 at the fall meeting of the American Welding Society, which will appoint contest judges.

The best paper emanating from an industrial source, consulting engineer, private or government laboratory, or the like, will get $750, with $500 offered for the second best paper and $250 for the third best.

A prize of $300 will be awarded for the paper, emanating from a university source, either instructor, student or research fellow, which is the greatest original contribution to the advancement and use of resistance welding. Second best will receive $200.

Minimum length of papers must be 2500 words and the closing date of the competition is July 31.

Additional and complete details may be obtained from the Resistance Welder Manufacturers Association, Citizens Building, 850 Euclid Ave., Cleveland 14, O.

RADAR FOR TRANSPORTS

A small, simplified radar to weigh about 100 pounds and compact enough for the average commercial or military transport plane is under development by *General Electric Company's* Electronics Department at Syracuse, N. Y., in accord with a contract awarded recently by the Air Material Command at Wright Field, Ohio.

Being designed to help remove some of the hazards of flying in darkness, fog or storm, the new unit is expected to increase the efficiency of "all-weather" airlines operations.

The radar is to be a further improvement over the military light-weight unit *G-E* built for the Army Air Forces during the last months of the war. This wartime radar, APS-10, with auxiliary power supply, weighed about 150 pounds and was operated by five controls, in contrast with the 500-pound, 34-control unit previously employed.

An outstanding feature of the new airborne radar will be its gyroscopically-stabilized antenna to leave the picture presented to the pilot unaffected as the plane banks, climbs or

dives. This refinement is expected to remove one of the main limitations to general use of the equipment during maneuvering flight. Power of the new radar will be increased eight times over the APS-10 version and maintenance provisions will be simplified. An extension of the present maximum range of 90 miles of the APS-10 is also anticipated.

While the new unit is not expected to be able to identify individual skyscrapers over New York, for instance, it will tell the pilot where he is in relation to ground objects he can identify and help him to avoid such structures as the Empire State building. In mountainous terrain, the *G-E* wartime radar can be adapted to indicate the direction and distance of mountain peaks and can give altitude of the aircraft regardless of barometric pressure. At airports which cannot afford blind landing facilities it can be used in conjunction with beacons for emergency blind approaches.

The unit can also locate severe storm areas over land and sea, though it cannot see into intense storms. Pilots can either avoid such areas or fly through storm "soft spots" as indicated on the radar screen.

NEW ENGLAND MEETING

An all-day New England radio engineering meeting is being planned for May 3 in Cambridge, Mass., by the North Atlantic Region of the Institute of Radio Engineers.

Six technical sessions, exhibits by leading manufacturers of the area, a luncheon and a banquet will be included in the meeting, to which anyone interested in radio and electronic engineering is invited. The entire program will take place at the Continental Hotel, Cambridge.

RECENT LITERATURE

FM by Federal

Booklets on *Federal* 10, 20 and 50 kw. FM transmitters, FM square loop antenna, and 5 and 50 kw. AM transmitters may be obtained by writing to the *Federal Telephone and Radio Corp.*, 591 Broad St., Newark 1, N. J.

AlSiMag Property Chart

The first chart on the mechanical and electrical properties of AlSiMag Ceramics to be published in about five years, Chart No. 346, has been released and is available to executives and engineers through the *American Lava Corp.*, Chattanooga 5, Tenn.

Demornay-Budd Catalogue

The latest catalogue of standard microwave components and test equipment of *Demornay-Budd, Inc.*, is available by addressing the company's Electronic Sales Division, 475 Grand Concourse, New York 51, N. Y.

V. H. F. Tuner

(*Continued from page* 5)

ode, when used as a converter, both as to input resistance and low noise, have been well established. These characteristics suggest the application of a double superheterodyne circuit. One such circuit[4] has been developed in which a single oscillator is used for both converters. This basic principle has been adapted to the present design.

Referring to the diagram in Fig. 5, the triode V_1 serves both as an oscillator and first converter, and triode V_2 serves as the second converter. Oscillator voltage injection for the second converter is obtained through the coupling capacitor from the plate of V_1. V_1 and V_2 are sections of the 7F8 twin-triode tube.

The frequency relationships are given in Fig. 5. The oscillator F_o beats with the incoming signal F_s to produce the first intermediate-frequency F_1, which is variable. F_1 then beats with the same oscillator frequency F_o in the second converter to produce the second intermediate-frequency F_2, which is 4.3 mc. With a 100 mc. signal the oscillator frequency is 47.85 mc. and the variable intermediate frequency is 52.15 mc.

The input resistance of the first converter can be increased by making its plate circuit inductive at the frequency to which the antenna circuit is tuned. The grid circuit loading due to grid-plate capacity then contains a negative resistive component, thereby neutralizing some of the positive resistance due to the transit time.

The following formulas are given for use in the design of short-length coaxial transmission lines such as are used in this tuner. The following symbols and units are used:

L—Inductance in microhenrys

l—Length, in.

μ—Relative ring permeability of powdered iron.

For the line[5] shown in Fig. 4A:

$$L = .0117l \log_{10} \frac{D_4}{D_1} \quad \ldots\ldots (1)$$

For the line shown in Fig. 4B which is completely filled with powdered iron:

$$L = .0117\mu l \log_{10} \frac{D_4}{D_1} \quad \ldots\ldots (2)$$

For the line shown in Fig. 4C with a powdered iron slug of the configuration shown, inserted its full length:

$$L = .0117l\left[\log_{10}\left(\frac{D_4 D_2}{D_1 D_3}\right) + \mu \log_{10} \frac{D_3 + d(\mu - 1)}{D_2 + d(\mu + 1)}\right] \quad \ldots\ldots (3)$$

When a maximum impedance (10 to 1) conductor diameter ratio is used the formulas (1), (2), and (3) simplify to (4), (5), and (6) respectively.

$$L = .0117l \quad \ldots\ldots (4)$$

$$L = .0117\mu l \quad \ldots\ldots (5)$$

$$L = .0117l\left[\log_{10}\frac{D_2}{D_3} + \mu \log_{10} \frac{D_3 + d(\mu - 1)}{D_2 + d(\mu + 1)}\right] \quad \ldots\ldots (6)$$

The effective permeability $\mu_{(EFF)}$ of the slug shown in Fig. 4C is obtained by dividing (6) by (4), or:

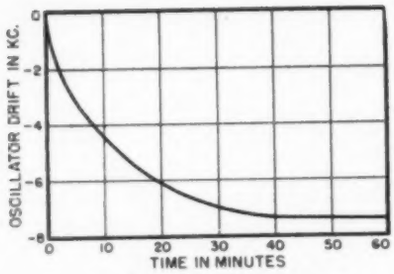


Fig. 6. Oscillator warm-up drift.

$$\mu_{EFF} = \log_{10}\frac{D_2}{D_3} + \mu \log_{10}\frac{D_3 + d(\mu - 1)}{D_2 + d(\mu + 1)} \quad \ldots\ldots\ldots\ldots (7)$$

The Q of a coaxial transmission line with a 10 to 1 ratio of outer to inner conductor diameters, shown in Fig. 4A, is given by[3]:

$$Q = .802\, D_1\sqrt{f} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

where f is the frequency in cycles per second. Eqt. (8) applies only to a line having air for the magnetic medium.

Thus for a line having an inner conductor diameter of 0.080 inches and an outer diameter of 0.800 inches, a Q of 640 is obtained at 100 mc. A 60 $\mu\mu$fd. capacitor resonates with 0.031 microhenrys at 115 mc. The length of line required is given by Eqt. (4), which is 2.65 inches.

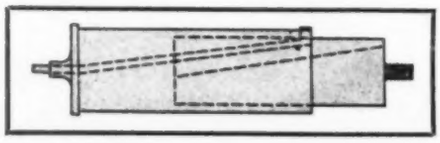
Powdered iron having a ring permeability of 3.5 is available, making it possible to choose the dimensions D_2, D_3 and d of Eqt. (7) to realize a $\mu_{(EFF)}$ of sufficient magnitude to cover the 88 to 108 mc. band.

The dial calibration of the v.h.f. tuner is between a straight line frequency and a straight line inductance. It gives about the same amount of "bunching" at the high frequency end that a gang condenser gives. By sloping the inner conductor as shown in Fig. 7 the calibration can be made to approach a straight line frequency over its useful range.

In this double superheterodyne system of reception the maximum to minimum frequency ratios of all of the tuned circuits are different. Tracking is obtained by using different lengths of transmission lines, thereby obtaining the $\mu_{(EFF)}$ required for each circuit.

The circuits are aligned by adjusting the position of the cores at the low frequency end of the band and adjusting the capacity at the high frequency end.

Fig. 7. Permeability tuned coaxial transmission line having linear frequency calibration.



By providing for these two adjustments, close tolerances on the permeability of the powdered iron slugs are avoided.

Fig. 6 shows the warm-up drift of the oscillator, which is tuned with an effective capacity of 250 $\mu\mu$fd. It should be noted that the oscillator is at approximately one-half the frequency of the signal and therefore the apparent drift is about twice that shown in the curve. The discriminator can be made broad enough to accept this amount of drift without distortion or compromising adjacent channel rejection unduly.

The temperature coefficient of the coaxial transmission line was found to be + 32 parts per million per degree centigrade. The iron core introduced an additional temperature coefficient of + 55 parts per million per degree centigrade. A ceramic capacitor with a negative temperature coefficient is used for compensation.

REFERENCES:

1. *Jaffe, D. L., "Intermediate-Frequency Amplifier Stability Factors," Radio, Vol. 30, No. 4, April 1946.*
2. *Terman, F. E., "Resonant Lines in Radio Circuits," Elec. Eng., Vol. 53, pp. 1046-1053, July 1934.*
3. *Wheeler, H. A., "Formulas for Skin Effect," Proceedings of IRE, Vol. 32, p. 418, September 1942.*
4. *Worcester, Jr., J. A., "Recent Improvements in Frequency-Modulation Receiver Design," R.M.A. Tech. Bull. 2, November 12, 1940.*

New Products

(Continued from page 22)

ute to low r.f. resistance. These include silver-plate copper contact terminals, large diameter copper-to-glass seals, and a multi-plate assembly brazed into a single unit. The new vacuum condensers have a capacitance of 100 $\mu\mu$fd.

Further information will be supplied by *Raytheon's* Power Tube Division, Waltham 54, Mass.

SOLENOID MOTOR

Rotonoid, a unique power device developed by *Radio Condenser Co.*, Camden, N. J., operates as a solenoid except that it rotates through 180°, thereby producing torque instead of a thrust and consequently eliminating the necessity of connecting linkages.

Originally designed for the operation of radio tuning units, especially in automobile receivers, Rotonoid has wide-spread application in many fields ranging from electromagnetic valves to adding and calculating machinery.

SYLVANIA C-R OSCILLOSCOPE

Portability, low cost and practical design for radio set servicing and general service applications are the features of the new Type 131 cathode-ray oscilloscope being manufactured by the Radio Tube Division, *Sylvania Electric Products Inc.*, 500 Fifth Ave., New York.

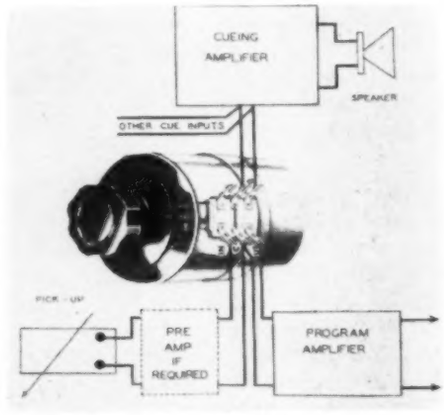
The signal frequency range is from 15 to 40,000 cycles and the sweep circuit of the device is built around a

Type 884 gas triode oscillator. Rated at 105/125 volt; 50-60 cycle; 40 watt input, Type 131 weighs 18 pounds.

DAVEN ATTENUATORS

Attenuators with a built-in cueing control, having wide application in broadcast stations, recording studios, wired music service and the sound film industry, have been announced by the *Daven Co.*

The control itself serves to transfer program material to a separate cueing amplifier, thus eliminating the need for additional switching devices. Provision is made at the extreme attenuation position for connecting the incoming signal to a cue circuit before "fading in" the signal, with the result that a program can be smoothly



brought in at the right time without the operation of additional switches.

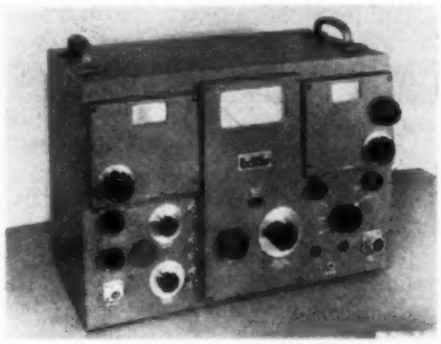
Further information on these units is available from the Sales Department of the *Daven Co.*, 191 Central Ave., Newark 4, N. J.

VHF FIELD INTENSITY METER

Model 106 VHF Field Intensity Meter for use in the television and FM bands from 50 to 220 mc. has been developed by *Clarke Instrument Corp.*

Enabling direct reading in terms of microvolts per meter without the use

of charts, curves or calculations over a range of 5 microvolts to 10 volts, the



instrument has a selectivity adequate for measurements on adjacent channels 200 kc. apart.

Additional information is obtainable from the manufacturer at 910 King St., Silver Spring, Md.

NYLON PHONOGRAPH NEEDLE

A phonograph needle designed with a nylon knee between aluminum shaft and sapphire jewel tip to give finer record reproduction is being introduced by *Webster-Chicago Corp.*

The nylon knee absorbs vertical shocks caused by the pinch effect of record grooves and levels out hori-

zontal shocks of needle "bounce." The internal resistance of nylon reduces needle scratch and surface noises and improves tracking at low needle pressure.

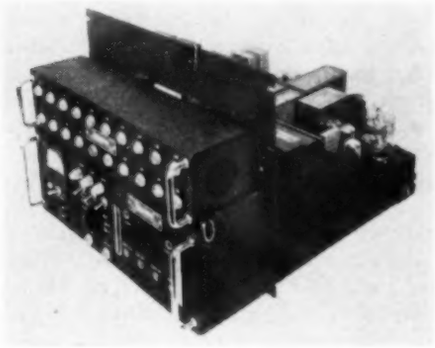
TUBE TEST EQUIPMENT

Equipment, consisting basically of four units, for life testing receiver type tubes under pulsed operating conditions, has been completed by *Chatham Electronics,* in cooperation with the *Evans Signal Laboratory.*

The apparatus includes a control panel, power unit, pulse modulator and tube test rack. The power unit is designed to provide all potentials normally required for receiver type tube testing. The modulator is designed to deliver a positive pulse, adjustable from 50 to 350 volts, to the grids of the tubes under test. Pulse current of 10 amperes at an .01 duty cycle is available.

Width of the pulse may be varied from 1 to 25 microseconds by means of plug-in type delay lines. Connections are provided for monitoring the modulator pulse amplitude and repetition rate.

Additional data may be obtained by writing *Chatham Electronics,* Equip-



ment Engineering Dept., 475 Washington St., Newark 2, N. J.

Multivibrators

(*Continued from page* 19)

(Fig. 7) is used as a time-base generator in many television receivers. Triggered by a negative-going input pulse, the multivibrator functions for one cycle in the conventional manner.

Initially one triode draws current while the other is cut off. Cumulative action, resulting from application of the negative control pulse, causes the first tube to conduct while the other is cut off. When the charge

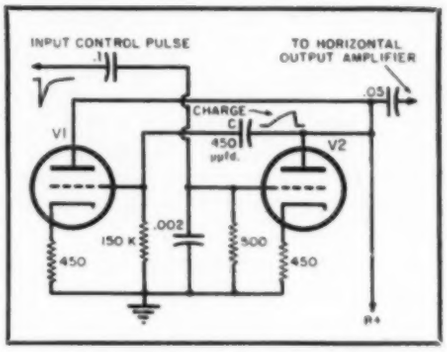


Fig. 7. One-shot multivibrator used as horizontal time-base oscillator for television receivers.

on condenser C (Fig. 7) decreases, the bias across the cathode resistor drops, and potentials on the tube electrodes revert to their original values. The circuit is then ready for another cycle of operation. The large negative bias on the grid of tube V_2 is responsible for the triangular shape of the output wave.

The multivibrator is also used in television for frequency division. In the circuit (Fig. 8), an input frequency of 3000 cycles is used to synchronize a multivibrator normally oscillating at about 500 cycles. By the use of tuned circuits in (external) stages following, satisfactory frequency division of 6 to 1, and even much higher, can be obtained. Such arrangements are commonly used in television synchronization signal generators to obtain waveforms of any desired frequency of recurrence.

Use in Radar

A wide variety of multivibrator circuits are used in radar and other

pulse-controlled electronic apparatus.

A one-shot multivibrator (Fig. 4) provides a square wave for triggering a time base generator. Circuit operation is similar to that described previously, the output being coupled directly from the plate of the first stage to the sweep stage of the equipment.

Radar applications also include use of the multivibrator to modulate radio frequencies in order to obtain squared pulses of rf. energy.

A balanced multivibrator is often used as a master oscillator in radar, similar to the arrangement shown in Fig. 6. *Two* outputs are taken from this oscillator; both similar in shape and amplitude—since they are taken

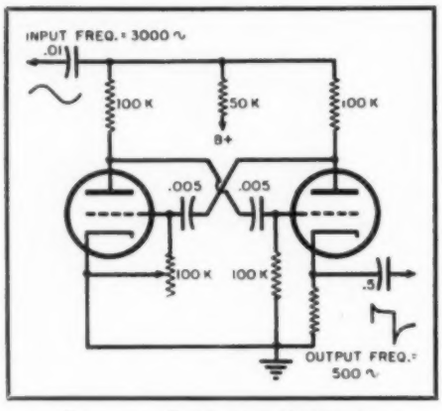


Fig. 8. Typical multivibrator used for frequency division (6 to 1) in television timing circuits.

from opposite points of a symmetrical circuit. But they lag each other by 180 degrees, a time delay which is put to important use in radar for synchronization of many precisely timed stages. The *range switch* provides selection of any of 5 fixed frequencies of multivibrator oscillation, by varying the *time constant* of the grid circuit. In principle, however, the circuit functions as a conventional, basic, free-running multivibrator.

BIBLIOGRAPHY

1. *Abraham, H. and Bloch, E., Pamphlet No. 27, French Ministry of War, 1918.*
2. *Eccles, W. H. and Jordan, F. W., Radio Review 1, 143, 1919.*
3. *Horton, J. W., Jour. A.I.E.E., 32, 730, 1923.*
4. *Horton, J. W. and Marrison, W. A., Proc. I.R.E., 16, 137, 1928.*
5. *Marrison, W. A., Proc. I.R.E., 17, 7, 1929.*
6. *Groszkowski, J., Proc. I.R.E., 18, 11, 1930.*
7. *Andrew, V. J., Proc. I.R.E., 19, 11, 1931.*
8. *Vecchiacchi, F., L'onde Electrique, May 1932.*
9. *Van der Pohl, B., Proc. I.R.E., 22, Sept., 1934.*
10. *Reich, H. J., Rev. Sci. Instr., 9, 222, 1938.*
11. *Toomin, H., Rev. Sci. Instr., 10, 191, 1939.*
12. *Vecchiacchi, F., Alta Frequenza, 9, 745, 1940.*
13. *Platley, H. W., British Patent No. 555078, May 1942.*
14. *Silver, McMurdo, Radio News, July 1944.*
15. *Kiebert, M. V. and Inglis, A. F., Proc. I.R.E., August 1945.*

Remote Amplifier

(Continued from page **13)**

used which heats simultaneously with the amplifier tubes thus preventing voltage surges. Because these close-spaced rectifier tubes sometimes short circuit from cathode to plate, S_1 is wired in such a manner as to guard against this trouble since both rectifier tube elements, except the heaters, are paralleled and a shorted rectifier tube would negate the effectiveness of the tube change switch S_1. Referring to Fig. 3, note that S_1 is wired so that two poles are for heater bank switching, the third pole switches the cathodes of the 84/6Z4s and the fourth pole switches the plates of the 84/6Z4 tubes. Thus, a shorted 84/6Z4 is completely isolated when the switch S_1 is is thrown. Incidentally, a shorted 84/6Z4 would blow the line fuse, therefore the tube change switch S_1 must be thrown before replacing the blown fuse.

Ample plate filtering is employed in addition to the added filters and decoupling circuits in each tube, therefore single section choke CH_1 is sufficient. The milliammeter is bypassed by C_{18} because the center tap of the high voltage winding carries considerable a.c. and goes through a rather long meter impedance path before going to ground.

The center tap of the heater winding is returned to the cathode of V_3 through a filter comprised of R_{20} and C_{14}. This arrangement places the heater winding at a plus potential of 8 volts and reduces to a minimum any hum due to cathode leakage in tubes V_3 and V_{3a}.

Incoming program lines are connected by a male plug to P_2. An external ground, if necessary, is also connected through P_2.

All parts are electrically oversized by at least 100 per-cent, and are of standard reliable manufacture. Parts failures due to overload should be nonexistent. As a further precaution against moisture, humidity and other corrosive elements, a small muslin bag of silica gel which is an active dehydrator is tucked away somewhere within the cabinet. The silica gel also inhibits contact oxidation in the switches, plugs and sockets.

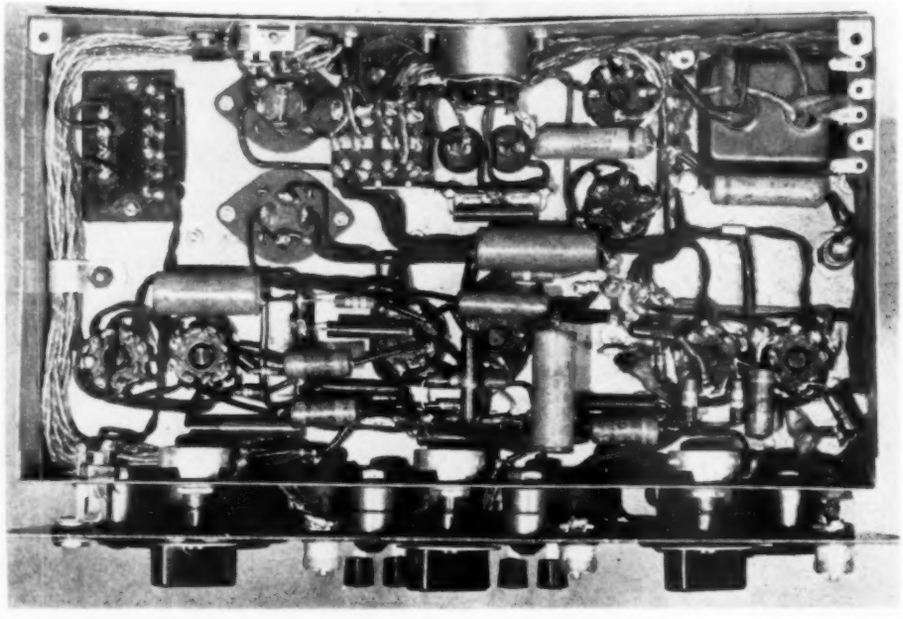
Wiring

Heater circuits are wired in first using twisted solid No. 20 wire, well away from the input circuits. The output lines are then bundled from S_2 and run to the *Jones* 12 contact socket P_2. Resistors and condensers are then wired into their circuits as directly as possible. Fig. 4 illustrates the wiring technique. All grounds from each circuit element requiring grounding are returned to one point on the chassis which is made convenient by using a number of long-spaded solder lugs passed through a 6/32 screw. Pins 1 and 6 on sockets V_1 must be grounded.

Microphone and phono connectors should be insulated from the front panel by extruded fiber washers in order to return the shells of these connectors to the central grounding point. Cloth-covered shielded single conductor cable is used between the input connectors and their circuit termination. Small cable clamps and tie strips are valuable assets for a neat job.

Professional panel lettering is attained with the *Millen* 59001 Panel Marking Kit Decalcomanias. This let-

Fig. 4. Bottom view of chassis shows wiring and location of components.



tering, particularly after lacquering, is very resistant.

Pilot lights are 12-16 volt rated and give sufficient illumination although operated on 6.3 volts. They should operate indefinitely.

The circuit has a usable mike gain of about 70 db. and about 30 db. for the phono input. This permits the pots to be turned up 60 to 85 per-cent of full rotation using crystal mikes of between —45 to —60 db. output. Exceptionally smooth gain variation for mixing, fade-ins and fade-outs is thus attained.

The noise level is down —62 db. relative to a 500 ohm resistance loaded output of plus 6 db. Frequency response is flat within ½ db. from 100 to 9500 cycles. A 50 cycle limit within ½ db. can be obtained by using larger values of audio coupling capacitors. This low frequency feature, though is not usually desirable since more equalization together with its attendant ills would be required at the other end of a program line. For lines of 5 to 10 miles, or even longer, it would be expedient to decrease the audio coupling capacitors even further.

Many functional possibilities of this amplifier outside the realm of broadcasting should suggest themselves in the general field of audio applications.

Small Radio Tubes

(*Continued from page* 11)

smaller dimensions, the glazing technique offers the general advantage that the bulb can be made in a definite shape, accurate to 0.1 mm., and that it keeps this shape during the sealing. A particularly undesirable result of the softening of bulb and base plate calls for special mention. If the diameter is very small the whole base plate may become soft during the sealing process and the contact pins fall into an oblique position or even shift slightly out of place. The pins then have to be bent straight again, and in order not to crack the glass the pins have to be made of a soft material, but then there is the risk that the pins may be easily bent when the tube is used and thus no longer fit the tube socket. With the glazing technique all these complications are avoided, the base plate retaining its shape perfectly, thanks to the low sealing temperature. Thus with the small diameter of the *A* series as well as with the larger diameters of the *B* and *C* series the pins can be made of hard material.

As far as the temperature of the cathode during the sealing process is concerned, the diameter of the tubes could have been chosen considerably smaller than 22 mm. It is mainly the capacities and the losses of the leads which now set the limit. How far the diameter can be reduced now depends in the first place on the number of pins to be placed in the base plate; in the second place it depends on the heat development in the tube, which determines the working temperature of the envelope and thus affects to a large degree the dielectric losses and any electrolysis of the glass between the pins.

The number of pins needed and also the heat development vary widely for different types of tubes. For a rectifier tube for a radio set four pins is enough; for the most complicated tube of an ordinary receiver, namely an indirectly heated mixing tube for a triode-hexode system, at least eight pins are needed, six for the electrodes (the cathode is common to the triode and hexode parts and two pairs of grids can be interconnected) and two for the cathode heating. Thus in principle there could be a minimum diameter for each type, but obviously this would be very impractical, not only for the manufacture of the tubes but also for the designing of the set, where the object is the greatest possible standardization of the components. Therefore one diameter has been chosen for the whole of the *A* series, large enough for the maximum number of eight pins and without risk of undesirable phenomena arising due to excessive temperature of the bulb with the highest total dissipation occurring in a tube for an ordinary receiving set, namely 14 watts (developed in a 9 w. output pentode, which has a long cathode for the sake of a large slope—and therefore a cathode power of 4½ w.).

The desire for standardization first mentioned as one of the motives in the determination of tube dimensions has led to international agreements about these dimensions among manufacturers of tubes. The dimensions chosen by us for the *A* technique, just as those for the *B* and *C* technique, are now accepted as standard dimensions also in the British and French radio tube industries (British Valvemakers Association and Compagnie des Lampes). Several structural details of the *A* tubes, mainly connected with the guiding mechanism to be discussed further on, were worked out in consultation with the British Valvemakers Association.

The diameter of 22 mm. chosen for the *A* technique is also more than sufficient from the point of view of voltage security. It was even found in the case of a special television tube, in which a peak voltage of 8000 volts occurs, that that voltage could be ap-

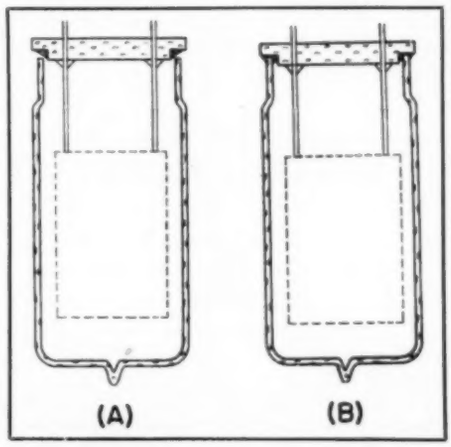


Fig. 5. Joining bulb and base plate by glazing technique. (A) Base plate with fused ring of glaze is laid loosely on edge of bulb. (B) As glaze melts, edge of bulb penetrates glaze, making a vacuum-tight seal.

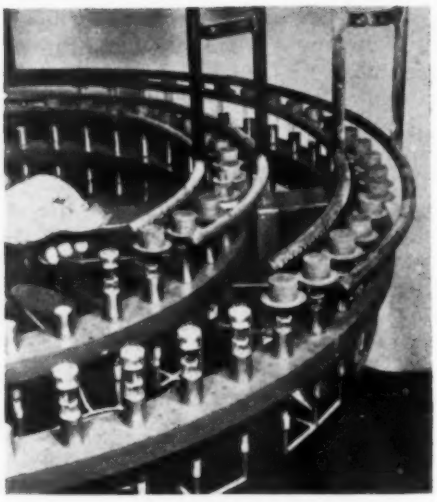


Fig. 6. Detail of the sealing machine on which bulb and base plate are joined.

plied between two diametrically opposite contact pins with no fear of electrolysis of the glass or breakdown.

In the U.S.A. very small tubes of all-glass construction have also been developed in recent years with a diameter of only 17 mm. (so-called midget tubes). These tubes do not contain more than 7 contact pins; an indirectly heated mixing valve of the triode hexode type cannot, therefore, be made in that type, and an output pentode only if a smaller slope or a smaller power is accepted or if the objections of a high bulb temperature are taken into account.

Construction of the Electrode System

In general it is desirable to construct the electrode system in radio tubes so that it stands free of the wall on two or three supporting rods. This is not only simpler than supporting the system with rings or the like against the wall, but it also involves less danger of distortions when the system is being placed in the bulb. This free-standing construction, however, becomes difficult when the diameter of the bulb is small, because of the risk of the electrode system striking up against the bulb wall when the tube suffers shock or vibration, thus giving rise to all kinds of crackling noises when the tube is in use.

The chosen diameter of 22 mm. is just large enough for the free-standing construction to be used in most types of tubes, for instance a triode-hexode, a pentode, a diode-pentode, etc., all of which have a length of 43 mm.

The glazing technique is especially suitable for tubes for battery receivers. In such tubes it is very important to limit as far as possible the power necessary for heating the cathode. This leads to the use of a directly-heated cathode, and of the thinnest possible wire (coated with a very thin layer of some good emitting oxide).* With the customary nickel wire it is impossible to go farther than 20 microns because of its low tensile strength. It was for this reason that several years ago already *Philips* started using for their battery tubes a cathode of tungsten wire, which has a much higher tensile strength and can therefore be made much thinner. Tungsten wire, however, is more sensitive to oxidation than nickel wire. Here again the low temperature of sealing in the glazing technique offers a great advantage. The thickness of the cathode wire has now been reduced to 9 microns, for which a heating current of only 12.5 ma. is needed.

Placing the Tubes in the Holder

A radio tube and its socket must be so constructed that when the tube is placed in the socket the pins are always correctly matched to their contacts. This used to be accomplished in most cases by placing the pins in the base at unequal distances from each other, but with this method it is difficult to set a tube in its socket correctly where the latter is placed in a less easily accessible position in a receiving set; in the case of small glass tubes, where the old sealing technique made it necessary to use pins of soft material, the pins are sometimes forced when the tube is being set in its socket and this is apt to lead to cracks in the glass.

Another method, which is used in the *A* series, as already in the *B* and *C* series, consists of placing the contact pins at equal distances apart and introducing a guiding mechanism to determine the position in the socket. In the case of the tubes of the *B* and *C* series, this consisted of a stud in the middle of the base plate. In the *A* series the mechanism is somewhat different. To the lower part of the bulb, where it is constricted, a metal ring is cemented. This ring is provided with a stud in the form of a small rounded projection which fits into a corresponding groove in the edge of the tube socket (hence the name "Rimlock" tubes). The fact that, thanks to the low sealing temperature in the glazing technique, the bulb keeps its shape accurately makes it possible for the metal ring to be fitted closely around the bulb with only a very small tolerance, without exceeding the diameter of 22 mm.

The constancy of shape of the bulb even makes it possible to dispense with the metal ring and to blow the stud in the glass wall of the bulb itself as a slight protuberance. In this way a remarkably simple construction is arrived at. For ultra-short waves this solution is of especial advantage since the metal ring would cause a very undesirable increase in the capacities of the leads.

**In these tubes the proportionately smaller cathode surface of the thinner wire has practically no effect on the tube characteristics.*

PHOTO CREDITS

Page

6, 7.....Illinois Tool Works

9, 21....National Bureau of Standards

10, 11, 30.....Philips Technical Review (North American Philips Co., Inc.)

16.....Collins Radio Co.

REFERENCES

1. *Philips Techn. Rev. 4, 162, 1939.*
2. *Philips Techn. Rev. 6, 319, 1941.*
3. *See for example Philips Techn. Rev. 3, 103, 1938.*

Circuit Loading

(*Continued from page 8*)

a 10 per-cent decrease in C_2 during the cycle. It is immediately seen that the percentage change required for C_2 is greater for smaller values of α than for larger values of α.

In case (4) instead of considering C_2 adjustable, the circuit element L is adjustable and C_2 fixed. Then apply these conditions to the parameters specified in case (1) and (2). For the low value of α, the operating point in the K-tan δ_L plane would terminate at A_7 meaning that L would have to decrease so that the ratio of L/C_1 would be equal to 0.0013. This amounts to a decrease of about 31 per-cent in order to maintain R_L constant. However, for the large value of α equal to 10, the terminating point would be B_7, which requires that L/C_1 increase to 0.0785. This amounts to an increase of about 25.6 per-cent for L in order to maintain R_L constant.

One might question the possibility of adjusting both L and C_2 in order to maintain R_L constant throughout the heating cycle. This is possible but introduces additional complexities of two simultaneous drives for loading purposes.

Instead of adjusting a series capacitance as C_2, it is possible to maintain constant loading at the optimum value of R_L by adjusting C_L. This procedure permits β to vary so that a complete compensation of the variation in R_L due to changes in tan δ_L is possible. This arrangement is algebraically satisfied as α approaches infinity and then R_L reduces to

$$R_L = \frac{(1+\beta)^{1/2}}{\beta \tan \delta_L} \sqrt{\frac{L}{C_1}} \qquad (11)$$

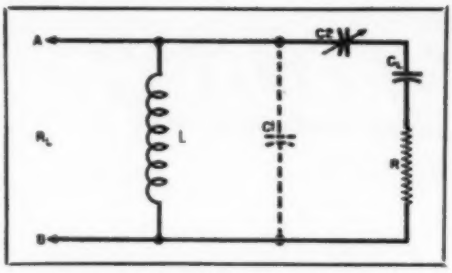


Fig. 6. The adjustable tank circuit permitting satisfactory tube loading by varying the condenser C_2.

The functional relationship between β and tan δ_L is very simply obtained by letting $R_L/\sqrt{L/C_1}$ equal k, then the value of C_L must vary so that β satisfies

$$\beta = \frac{-1 + \sqrt{1 + 4k^2 \tan^2 \delta_L}}{-2k^2 \tan^2 \delta_L} \quad \ldots\ldots (12)$$

throughout the heating cycle.

A practical dielectric heating unit incorporating the automatic adjustment feature where α is infinity and β is adjusted to compensate for variations in tan δ_L is shown in Fig. 1. Two capacities, C_L, are used because of the push-pull circuit used. The box shaped housings directly above the condenser-plate supports include motor drives which raise or lower the plates as required during the dielectric heating cycle. Another unit which incorporates the features of case (3) with C_2 adjustable is shown in Fig. 2. The two capacities, each taking the place of C_2 in Fig. 3 are used again because of the push-pull circuit arrangement used. By referring to the photograph shown in Fig. 2 it will be noticed that the upper plates are fixed by means of insulator supports while the lower plates are motor driven so that α may be adjusted to compensate for the variation of tan δ_L and β during the heating cycle.

The analysis of the principles of circuit loading in dielectric heating as presented in this article is available for future reference and application by referring to the operating chart. One will find other very useful and practical equipment information by carefully studying all the possibilities presented by this chart in addition to those presented here.

REFERENCES

1. *Grinstead, L., "Dielectric Heating by the Radio Frequency Method," The Journal of the British Institution of Radio Engineers, Vol 5, No. 3, May-July, 1945.*

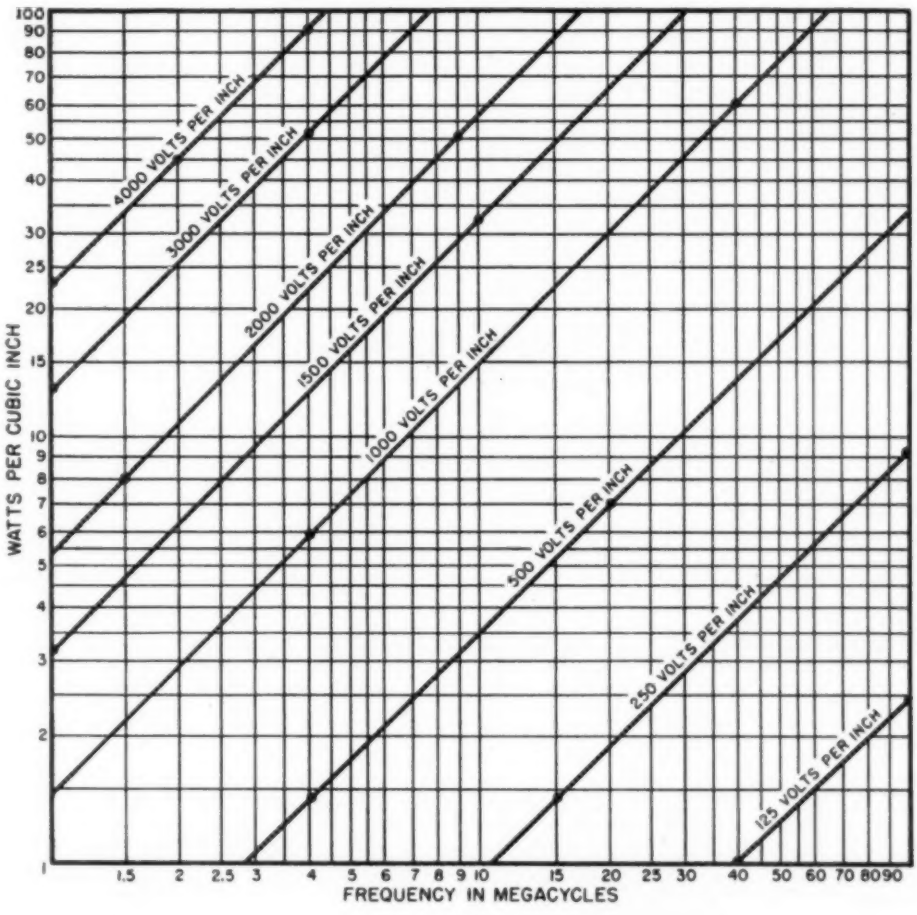
2. *Mittelmann, E., "Rematching in Electronic Heating," Electronics, Feb. 1945.*

3. *Mittelmann, E., and Bosomworth, G. P. "Electronic Rubber Preheater." Electronics, March, 1946.*

4. *Mittelmann, E., "R-F Heating of Plastics," Radio Electronic Engineering, May, 1944.*

5. *U. S. Patent 2,324,525.*

Fig. 7. Relation of voltage gradient and frequency for a given power concentration based on ϵ tan $\delta_L = 1$.



MARCH

3-6, inc.—**I.R.E. Convention and Radio Engineering Show,** Grand Central Palace, New York City, with headquarters at the Commodore Hotel. In addition to the technical sessions, there will be a display of radio-electronic engineering equipment said to be the largest and most interesting ever assembled on one floor.

17, 18, 19—**Chicago Production Show and Conference,** Stevens Hotel, Chicago.

APRIL

19—**Chicago I.R.E. Conference,** Northwestern Technological Institute. This conference will feature an all-day series of technical sessions and discussions on the practical side of electronic engineering, with emphasis on applied electronics.

MAY

11-16, incl.—**National Radio Parts and Equipment Show,** Stevens Hotel, Chicago.

* * *

MONTHLY MEETINGS

Institute of Radio Engineers, Chicago Section. Don Haines, Secretary, CAPitol 6500.

Dinner 5:45 P.M., Electric Club 38th floor, Civic Opera Building. Program 7:00 P.M., 6th floor, Civic Opera Building, 20 N. Wacker Drive.

March 21—"Direct Viewing Television Receivers" by A. Wright and "Projection Television Receivers" by E. L. Clark, both of *RCA Victor Div.*, Camden, N. J.

* * *

American Institute of Electrical Engineers, Chicago Section. J. E. Hobson, Secretary, 35 W. 33rd St., Chicago 16, VICtory 3300.

Supper, Ford Hopkins Cafeteria, 3rd floor, Civic Opera Building. Food served from 5:30 to 6:15 P.M.; no reservations required. Program, 7:00 P.M., 6th floor, Civic Opera Building, 20 N. Wacker Drive.

March 6—Communications Group—"Wave Guides for Electrical Transmission" by W. A. Tyrrell, *Bell Telephone Laboratories.*

March 13—Power Group.

March 27—Electronics Group—"Stratovision" by C. B. Nobles, *Westinghouse Electric Corp.*

MONEY ISN'T EVERYTHING-

(OR IS IT?)

BY GROUCHO MARX

WHAT do you want to save up a lot of money for? You'll never need the stuff.

Why, just think of all the wonderful, wonderful things you can do *without* money. Things like—well, things like—

On second thought, you'd better keep on saving, chum. Otherwise you're licked.

For instance, how are you ever going to build that Little Dream House, without a trunk full of moolah? You think the carpenters are going to work free? Or the plumbers? Or the architects? Not those lads. They've been around. They're no dopes.

And how are you going to send that kid of yours to college, without the folding stuff? Maybe you

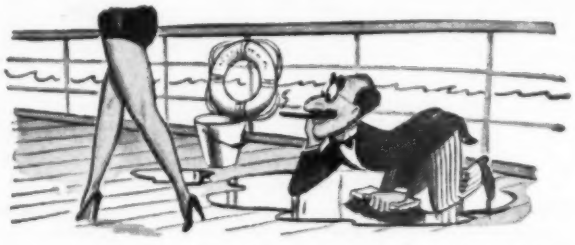
think he can work his way through by playing the flute. If so, you're crazy. (Only three students have ever worked their way through college by playing the flute. And they had to stop eating for four years.)

And how are you going to do that world-traveling you've always wanted to do? Maybe you think you can stoke your way across, or scrub decks. Well, that's no good. I've tried it. It interferes with shipboard romances.

So—all seriousness aside—you'd better keep on saving, pal.

Obviously the best way is by continuing to buy U. S. Savings Bonds—through the Payroll Plan.

They're safe and sound. Old Uncle Sam *personally*



guarantees your investment. And he never fobbed off a bum I.O.U. on *anybody*.

You get four bucks back for every three you put in. And that ain't hay, alfalfa, or any other field-grown product.

Millions of Americans—smart cookies all—have found the Payroll Plan the easiest and best way to save.

So stick with the Payroll Plan, son—and you can't lose.

SAVE THE EASY WAY... BUY YOUR BONDS THROUGH PAYROLL SAVINGS

Contributed by this magazine
in co-operation with the Magazine Publishers of America as a public service.

GENERATING MICROWAVES

By SAMUEL FREEDMAN*

Type 410-R klystron. Connections shown are the accelerating and buncher resonating grids.

Disc seal type of transmitting tube suitable for ultra-high frequency operation.

Typical magnetron capable of developing about 300 kw. peak power for radar pulsed power transmission. It contains 8 cavities and is designed to operate fixed frequency in the 3000 mc. region. A magnet fits against the flat surfaces.

In generating microwaves various types of tubes may be used, ranging from conventional radio receiving tubes to the more expensive magnetrons; each and every one has its special advantage.

THE increasing utilization of radio principles for innumerable types of fixed, portable and mobile communication and navigation can only be achieved by the development of additional frequency spectrum.

Except in the most limited way, this must be accomplished by the development of tubes, circuits and techniques capable of functioning on wavelengths shorter than ever before put to common use. The utilization of shorter and shorter wavelengths have now brought us into the microwave regions known as the ultra-high and super-high frequency bands.

Ultra-high frequencies are those lying between 300,000 and 3,000,000 kilocycles. Super-high frequencies are those between 3,000,000 and 30,000,000 kilocycles. Together they represent those wavelengths shorter than 1 meter and longer than 1 centimeter. One centimeter today is by no means the stopping point. It is merely a convenient resting point on our road towards the infrared region which starts at about a hundredth of a centimeter. This will correspond to about three billion kilocycles.

Each time we halve the wavelength, such as from 2 centimeters down to 1 centimeter, we double the amount of frequency spectrum previously considered feasible to utilize. There is now no limit in sight as to the ultimate amount of frequency spectrum which may be developed in order to provide for existing or potential radio stations and services. The infrared light spectrum, and ultraviolet regions do not stop until a frequency of 25,000,000,000 megacycles has been reached.

Progress in the utilization of these frequencies becomes increasingly hampered as the wavelength is reduced. This is due to the wide differences of opinion between the conforming and non-conforming experts in their radio thinking. The conformists are much better educated and more formally trained as engineers and physicists. They also enjoy or dominate the best facilities and backing in their work. The non-conformists (which include the author) have, however, made many worthwhile contributions to the art. They do it in direct conflict with prior mathematical and theoretical conceptions of the limitations believed to be involved. Past experience indicates that many revolutionary developments originate with non-conformists. The ultimate development of such ideas, however, require the large scale participation by the conformists. The latter make their advanced mathematics and theories fit the new facts or discoveries by taking into account some new relevant factor which was not previously known or adequately evaluated.

As tubes are utilized for microwaves, problems arise which were of little concern at the lower frequencies of the past. These problems are as follows.

1. *Inter-electrode capacitance* as represented by the metallic tube elements and the spaces between them. This capacitance, small as it may be, makes it difficult, or impossible, to resonate the associated circuit high enough in frequency or low enough in wavelength as required when operating on microwaves.

* The author is co-inventor of the Fonda-Freedman series of inventions which make possible the utilization of conventional radio tubes to generate ultra- and super-high frequencies. He is the author of the book "Two-Way Radio" published by Ziff-Davis Publishing Company.

TABLE 1. FUNCTIONAL COMPARISONS OF MICROWAVE TUBES

FUNCTION	BARKHAUSEN-KURZ	KLYSTRON	MAGNETRON (NEGATIVE RESISTANCE)	MAGNETRON (TRANSIT TIME)	LIGHTHOUSE & SMALL CONVENTIONAL TYPES	FONDA-FREEDMAN CONVENTIONAL TUBES
The PERIOD	Electrons remain in the inter-electrode space different lengths of time. Some less, some more, than one period of oscillation, depending on the phase of the oscillation when they leave the cathode.	Electrons remain in the drift space a time approximately equal for all of them. They cross either the buncher or the catcher in a time much shorter than one period.	All electrons remain in the inter-electrode space less than one period of oscillation.	Electrons remain in the inter-electrode space more than one period of oscillation.	Electrons remain in the inter-electrode space less than one half of the period.	Electrons remain in the inter-electrode space more than, or as long as, one half the period of oscillation. It may also remain more than, or as long as one period for the alternative development.
INTERESTING BEGINNING OF ENERGY INTERCHANGE	When electrons leave the cathode.	When electrons cross the buncher.	When electrons leave the cathode.	When electrons leave the Critical.	When electrons leave the cathode.	When electrons leave the cathode.
INTERESTING END OF ENERGY INTERCHANGE	(a) When electrons with transit time longer than period strike the grid. (b) When electrons with transit time shorter than period strike the cathode.	When electrons cross catcher.	When electrons strike anode or are returned to cathode.	When electrons strike anode or are returned to cathode.	When electrons strike the anode.	When electrons strike the anode.
The OUTPUT	Energy is absorbed by the above electrons (b) and delivered by electrons (a). Useful output is the difference thereof.	Energy is absorbed by electrons in the buncher and delivered in the catcher. Useful output appears as the difference thereof.	More electrons strike negative section of the anode than the positive. Useful power output results from negative conductance.	Energy is absorbed from the d.c. field every positive half period and delivered to the a.c. field every negative half period. A smaller amount of power is absorbed from the a.c. field during the positive half periods. This is a loss.	Power output is effect of negative conductance. A loss appears as a result of grid conductance.	Power output is effect of negative (dynamic) conductance. There is no loss.
HOW OUTPUT IS OBTAINED	By making the grid positive and the plate negative. The electrons cross the grid several times before being collected on it.	By the special structure of the tube which results in velocity modulation in the buncher and electron bunches thereafter.	By deflecting the path of electrons by means of a magnetic field and use of proper relation between frequency and d.c. voltage.	Same as for other type magnetron.	By making the inter-electrode distance very small.	By making the inter-electrode distance large as in conventional tubes or otherwise, and adjusting the transit time to an integral multiple of (half) periods so that electrons flow in groups.
REQUIRED	That the anode be a grid which MUST be crossed by electrons, and that on the other side there be present a negative repelling plate.	That the catcher be crossed by electron bunches with the proper phase.	That the magnetic field be axial and have the proper intensity.	Same as for other type magnetron.	That the transit time be small when compared to the period of oscillation.	That the d.c. voltages be adjusted to produce the required phase relations between groups and a.c. voltages.
ENERGY LOSSES	Energy is wasted by the (b) electrons.	Energy is wasted in the buncher.	Energy is wasted by electrons striking back the cathode or absorbing power during positive half periods.	Energy is wasted by electrons arriving on the positive section of the anode.	Energy is wasted due to grid conductance.	None of these.
ADJUSTMENT ETC.	Not critical.	Not critical.	Critical.	Very critical. Requires high voltages. Frequency not very flexible.	Not critical. Limited power due to small electrodes.	Not critical nor limited in power.
APPROXIMATE MAXIMUM FREQUENCY	UHF	SHF	UHF	SHF	UHF	SHF
COST FOR TUBE	———	Up to $60 or more.	———	Up to $200 or more.	Up to $20.	Conventional tube prices 50c and up.
FREQUENCY FLEXIBILITY	———	Limited.	Limited.	Limited.	Unlimited.	Unlimited.

2. *Transit time* as represented by the amount of time which it takes an electron leaving the cathode to reach the plate or anode. Even though this time may be as short as a billionth of a second, it is equal to the time it takes 30 cycles to develop on a wavelength of 1 centimeter. When the transit time exceeds about an eighth of a cycle, the tube and circuit begin to seriously misbehave by conventional techniques.

3. *Phase shift or reversal* resulting from the fact that the electron leaving the cathode will arrive at the plate considerably different with respect to its relative position for the oscillating cycle.

4. *Miscellaneous factors* such as grid conductance, skin effect, dielectric losses, direct radiation by the tube elements and radiation of the connecting leads. These losses, while present and recognized, may be sufficiently controlled or compensated for by efficient techniques. They are not as serious as the first three problems enumerated above.

The principal consideration in microwave utilization is tubes to generate or detect such extremely high frequencies. This is achieved today by the following tubes or techniques:

1. The klystron or other forms of velocity modulated tubes.

2. The magnetron or tubes where a magnetic field serves in lieu of a grid.

3. The lighthouse or other forms of disc seal tubes.

4. Conventional tubes in special simple circuitry such as the Barkhausen-Kurz and the Fonda-Freedman techniques.

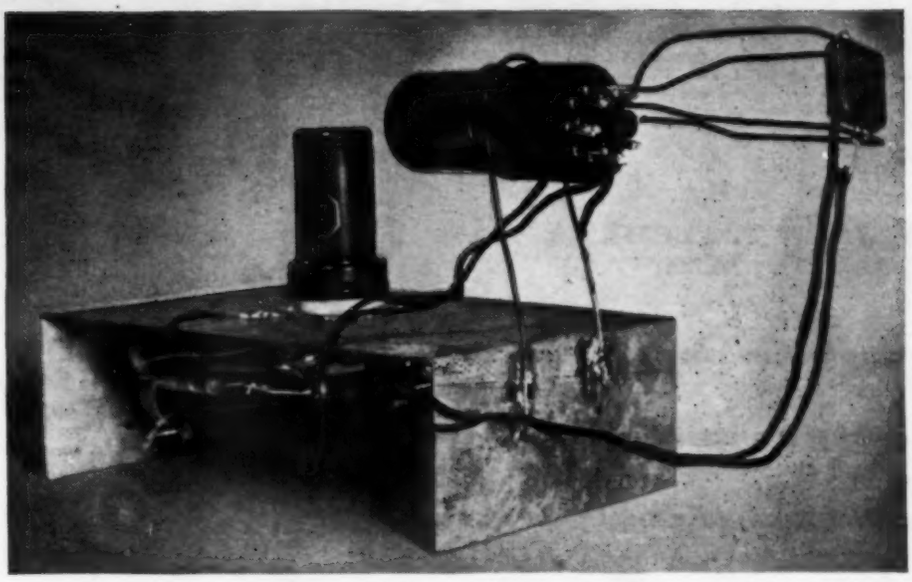
In any tube, three prime provisions must be recognized, namely: *a.* The production of electrons such as by heating of a cathode. *b.* The controlling of electrons produced by the cathode through the use of grids suitably biased or energized. The exception will be the magnetron where a magnetic field serves this purpose. *c.* The gathering up of the electrons and making them available as useful power in an external circuit. This is normally the function of the plate or anode. It ceases to be so in the case of the Barkhausen-Kurz technique or in certain types of velocity modulated tubes where the grid is kept more highly positive than the plate.

The klystron or velocity modulated tube is as different from a conventional tube as amplitude modulation differs from frequency modulation. A conventional tube depends primarily upon the numbers of electrons, whereas the velocity modulated tube depends on the changes in the velocity of electrons as they travel from the cathode to succeeding tube elements. Any impressed signal manifests itself by the speeding up or slowing down of the electrons. This includes the overtaking of slower moving electrons by faster moving ones with the result that they bunch up along the electron path.

This type of tube contains the following: *a.* A heater to heat the cathode. *b.* A cathode to emit electrons. *c.* An electron gun or path to beam the electrons which are accelerated in the space between the cathode and the first pair of accelerating grids. *d.* A pair of closely spaced accelerating grids which are kept highly positive to attract and accelerate the electrons through its perforations to the buncher grids except for those which strike the grids. *e.* A pair of "buncher" or "resonator" grids which are acted upon by the electrons that were both accelerated and able to get through the accelerating grids.

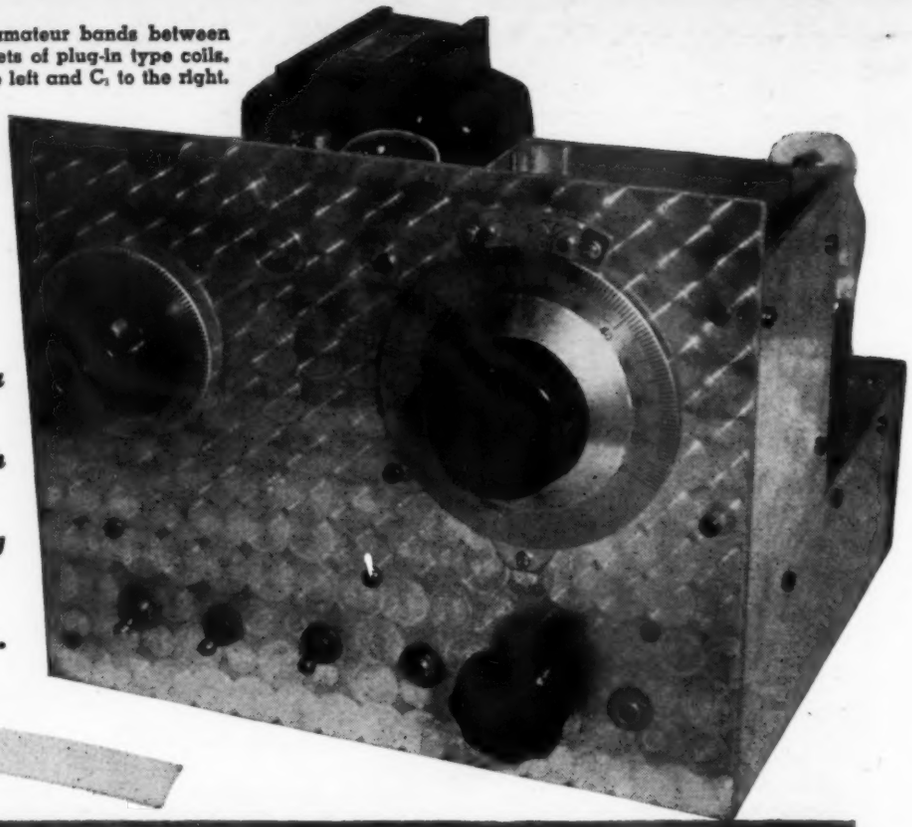
The acceleration of the electrons in passing the highly positive accelerating grids corresponds to a small fraction of a cycle of time even at microwave frequencies. A radio frequency field in the buncher resonator produces an alternating or oscillating electric field between the buncher grids. Electrons in transit will either be speeded up, slowed down or proceed in a normal manner depending on the state of the oscillating field as the electrons pass the buncher grids. This change in velocity gives the tube technique the name of "velocity modulation." Since some electrons approach the grid as it becomes less positive while others do so as it becomes more positive, a situation exists

(*Continued on page* 125)



The first satisfactory working model of the Fonda-Freedman technique wherein a 6N7 tube developed frequencies in the 300-3000 mc. region. Author reports that later versions reached all frequencies between 100-50,000 mc. Photo shows complete transmitter exclusive of conventional power supply needed for either c.w. or tone transmission.

Author at work in his laboratory. Photo shows preliminary working models of microwave transmitting, receiving, modulating, and electromagnetic horn equipment.



Panel view of home-built unit. All amateur bands between 20-80 meters can be covered with 2 sets of plug-in type coils. Tuning condenser, C_{1a}, is shown to the left and C_1 to the right.

By
JOHN F. CLEMENS,
W9ERN

Complete construction data for a 50-watt transmitter-exciter, with built-in power supply and using a variable frequency oscillator.

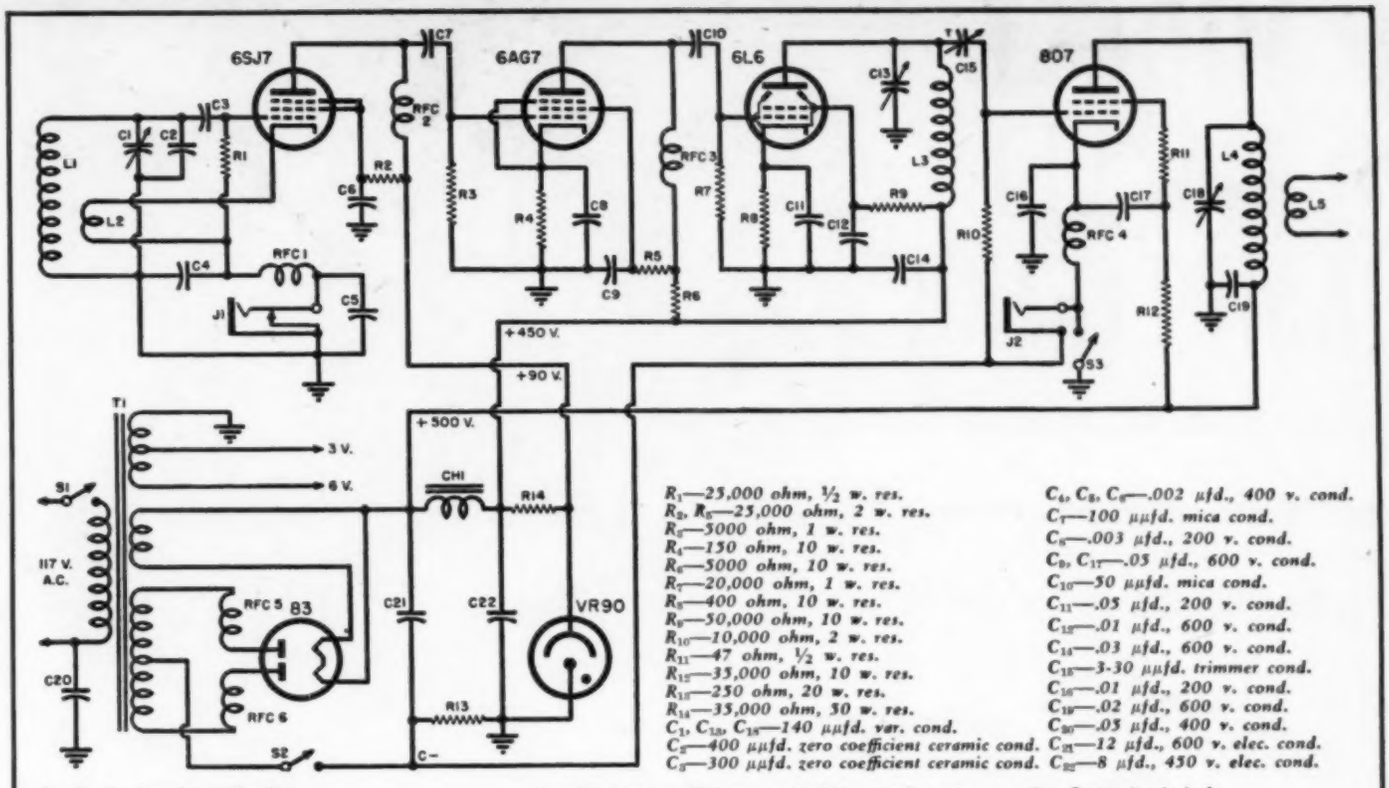
Variable Frequency TRANSMITTER-EXCITER

FOR those whose ham activities are restricted to a limited space, some ingenuity is necessary to build a transmitter which will permit a reasonable degree of operating success. The transmitter described here was designed primarily for compactness and makes a fine low-power transmitter or exciter for the operating table. For transmitters of under 100 watts an e.c.o. is almost a necessity these days as there is little chance of blasting a channel through the QRM. Considerable care has been expended on the e.c.o. in this transmitter to secure freedom from drift and roughness. Oscillator keying permits break-in operation and monitoring in the receiver. The keying is free from clicks and chirp and the signal quality will require no apology. Although this rig is operated on forty and eighty meters, a new set of coils will permit operation on twenty. Ten meter operation cannot be obtained without another doubler stage, unless the e.c.o. is operated on forty meters, and although several commercially built transmitters have adopted this expedient, it can hardly be considered good practice.

An investigation of numerous e.c.o.'s has revealed several facts which should be of interest to anyone planning a variable-frequency exciter.

First of all, mechanical stability is of prime importance. Although this fact is so well known as to be a truism, the method of achieving this mechanical stability does not always result in improved electrical stability. The only major item worthy of special mention is the method in which the e.c.o. tuning condenser is mounted, i.e., on a sub-panel attached, not to the chassis, but to the front panel. This method of mounting, in conjunction with the use of the *National* Type N dial which mounts on the front panel, prevents thrust forces from being transmitted to the variable condenser bearings. Those who have built e.c.o.'s have probably experienced instability from thrust force on the tuning condenser which is manifest as a frequency variation when the panel on the v.f.o. is touched or pushed. A double-bearing tuning condenser is used as an additional measure to insure stability. In tests with a number of different models, the double-bearing type of condenser showed a marked superiority over single-bearing types in eliminating backlash. The *National* Type N dial has proven satisfactory for v.f.o. use since it has high torque, no backlash, perfectly smooth action and a vernier scale which can be read accurately to one part in 1000. Other components of the oscillator, the tube, coil, and associated parts, are also rigidly mounted inside the e.c.o. compartment. The tube and coil sockets are raised one inch above the chassis by brass spacers so that the underside of these sockets is also inside the shield chamber.

The cut-and-try method of determining the tuning range of the oscillator can be eliminated by a few simple calculations. As an example, let us suppose it is desired to cover 1750 to 2000 kilocycles with the e.c.o. When doubled, this will, of course, tune the entire 80 meter band. From the formula, $f = 1/2\pi\sqrt{LC}$, it is evident that frequency varies inversely as the



R_1—25,000 ohm, ½ w. res.
R_2, R_5—25,000 ohm, 2 w. res.
R_3—3000 ohm, 1 w. res.
R_4—150 ohm, 10 w. res.
R_6—5000 ohm, 10 w. res.
R_7—20,000 ohm, 1 w. res.
R_8—400 ohm, 10 w. res.
R_9—50,000 ohm, 10 w. res.
R_{10}—10,000 ohm, 2 w. res.
R_{11}—47 ohm, ½ w. res.
R_{12}—35,000 ohm, 10 w. res.
R_{13}—250 ohm, 20 w. res.
R_{14}—35,000 ohm, 30 w. res.
C_1, C_{13}, C_{15}—140 μμfd. var. cond.
C_2—400 μμfd. zero coefficient ceramic cond.
C_3—300 μμfd. zero coefficient ceramic cond.
C_4, C_5, C_9—.002 μfd., 400 v. cond.
C_7—100 μμfd. mica cond.
C_8—.003 μfd., 200 v. cond.
C_{10}, C_{17}—.05 μfd., 600 v. cond.
C_{11}—50 μμfd. mica cond.
C_{12}—.05 μfd., 200 v. cond.
C_{14}—.01 μfd., 600 v. cond.
C_{16}—.03 μfd., 600 v. cond.
C_{18}—3-30 μμfd. trimmer cond.
C_{19}—.01 μfd., 200 v. cond.
C_{20}—.02 μfd., 600 v. cond.
C_{21}—.05 μfd., 400 v. cond.
C_{22}—12 μfd., 600 v. elec. cond.
C_{23}—8 μfd., 450 v. elec. cond.

L_1, L_2, L_3, L_4—See coil table
L_5—No. of turns depends on antenna feeder system used
RFC_1, RFC_2, RFC_3, RFC_5, RFC_6—2.5 mh. r.f. choke
RFC_4—1 mh. r.f. choke

T_1—Power trans. 778 v. c.t. @ 200 ma.; 5 v. @ 3 amps.; 6.3 v. c.t. @ 4 amps.
CH_1—10 hy., 60 ma. filter choke
S_1, S_2, S_3—S.p.s.t. toggle sw.
J_1—Closed circuit jack
J_2—Open circuit jack

1—6SJ7
1—6AG7
1—6L6
1—807
1—83
1—VR90

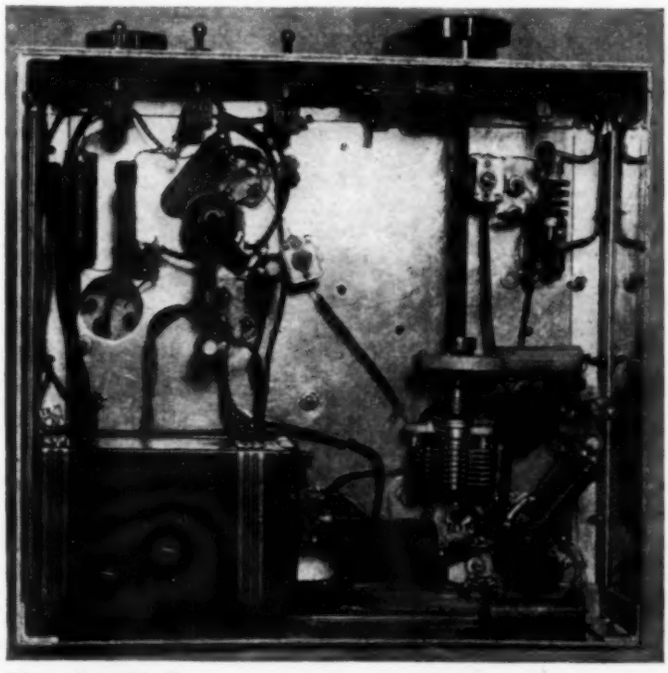
Schematic diagram of transmitter-exciter. In constructing this unit provision has been made for either oscillator or final amplifier keying.

square root of the tuning capacity. Therefore, the capacity ratio (maximum capacity across the tuned circuit divided by minimum capacity across the tuned circuit) will be the square of the frequency ratio. The inverse relationship may be forgotten since it only means that the highest frequency will be obtained at minimum capacity and vice versa. The frequency ratio in this case is 2000/1750, or 1.142. The square of 1.142, or 1.306 is therefore the needed capacity ratio.

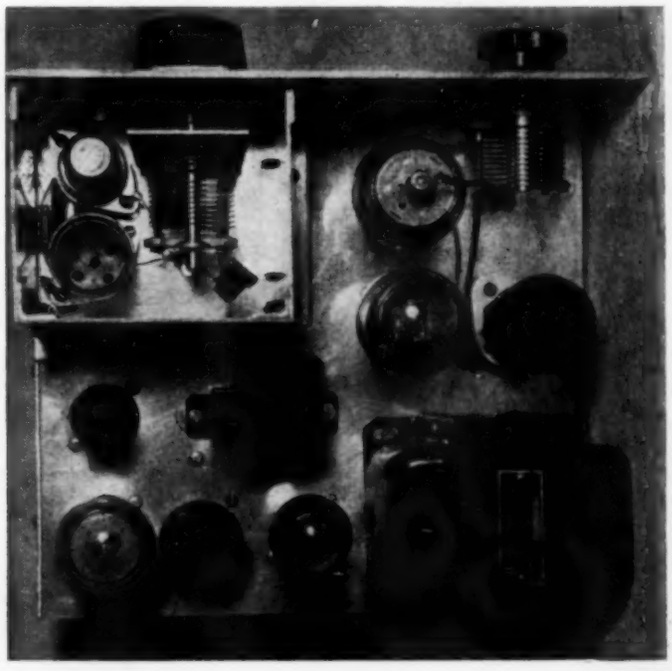
We must now decide what size tuning condenser to use, remembering that high-C circuits are a must for e.c.o. stability. The largest capacity generally available in the midget variety of condenser is the popular 140 μμfd. type and we will choose this value. We may estimate its minimum capacity at about 15 μμfd. We have, therefore, a *variable* capacity of 140 − 15 or 125 μμfd. We now know that $(125 + C)/C = 1.306$ from which $C = 408$ μμfd. C in the above equation is the

(*Continued on page* 158)

Rigid mounting of all parts is desirable for stable operation. Variable condenser shown is in the 6L6 plate circuit.



The oscillator stage (top view) is built in the shield box shown in upper left hand corner to provide circuit isolation.



MIDGET 4-WATT AMPLIFIER

By EARL SNADER, Jr.

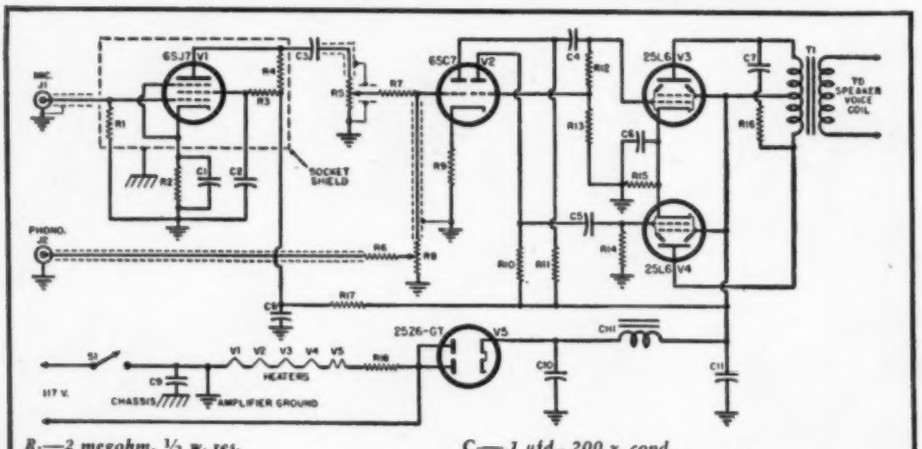
A compact, easy-to-build audio amplifier that features both phono and microphone inputs.

Over-all view of home built amplifier. Note that input jacks are located on the side flanges of the unit.

ONE of the chief difficulties encountered in the construction of high gain audio amplifiers is the presence of hum. This difficulty, involving the use of a certain minimum number of filter components and provisions for shielding, places severe limitations on the minimum size necessary for high gain amplifiers with any significant level of output. It is extremely difficult to conserve in space to a significant degree in the construction of amplifiers of this type.

Here is an amplifier which is unique on several counts. Most obvious is its small size. With the tubes inserted, the over-all measurements are four inches wide by three inches deep by only five inches high. Phonograph amplifiers with these approximate dimensions are relatively common. But this amplifier includes a microphone channel, designed to operate from the output of a low level crystal or dynamic microphone. It also has a separate phonograph channel, designed to operate from the output of a crystal phonograph cartridge of the low-voltage type. The power output stage of this amplifier consists of two 25L6 tubes operating in push-pull, driven by a 6SC7 which serves as amplifier and phase inverter. The microphone preamplifier tube is a 6SJ7. A 25Z6 is used as the rectifier. The two 25L6 tubes develop a power output of four watts, and this can be realized from either the microphone or phonograph channels separately or together. The mixing of the two channels is done through a resistance network permitting the output level of the one channel to be adjusted with no appreciable effect upon the other. With either or both the controls turned on full the hum level in the output of the amplifier is almost inaudible. The amplifier can be used for public address work in applications requiring four watts power or less, for playing phonograph records, or for making recordings. It is very efficient for the amount of space which it occupies. It will operate from 110 volts, either a.c. or d.c. All parts except the microphone and loudspeaker are built into the unit.

Schematic diagram of five-tube audio amplifier. The a.c.-d.c. operation not only simplifies operation of unit but reduces component cost.



R_1—2 megohm, ½ w. res.
R_2—1700 ohm, ½ w. res.
R_3—1 megohm, ½ w. res.
R_4, R_6, R_{10}, R_{11}—250,000 ohm, ½ w. res.
R_5, R_9—500,000 ohm pot.
R_7, R_{14}—500,000 ohm, ½ w. res.
R_8—4000 ohm, 1 w. res.
R_{12}—475,000 ohm, ½ w. res.
R_{13}—16,000 ohm, ½ w. res.
R_{15}—70 ohm, 2 w. res.
R_{16}—4000 ohm, 4 w. res.
R_{17}—25,000 ohm, ½ w. res.
R_{18}—110 ohm, 11 w. (minimum) line cord res.
C_1—20 μfd., 25 v. elec. cond.
C_2—.1 μfd., 200 v. cond.
C_3, C_4, C_5—.01 μfd., 200 v. cond.
C_6—20 μfd., 20 v. elec. cond. (Part of C_{10}, C_{11})
C_7—.03 μfd., 400 v. cond.
C_8—20 μfd., 150 v. elec. cond.
C_9—.05 μfd., 400 v. cond.
C_{10}, C_{11}—50/50 μfd., 150/150 v. elec. cond.
S_1—S.p.s.t. toggle sw.
J_1, J_2—Shielded jacks
T_1—Output trans. Push-pull 25L6 to v.c.
CH_1—15 hy. filter choke
1—25Z6 tube
1—6SJ7 tube
1—6SC7 tube
2—25L6 tubes

The amplifier is built on a standard 4" by 3" by 2" utility box. All five tubes and the filter condenser unit are mounted on the top cover of this box. The cover is taken off by removing the screws along each edge. The holes for the microphone and phonograph gain controls are drilled into the one 2" by 4" side of the utility box. This side serves as the front panel. These holes are bored midway from top to bottom, and 1⅛ inches from each end. The power switch is mounted in a hole midway between these two holes. The jacks for the microphone and phonograph inputs are of the standard microphone jack type, and are mounted at each end of the utility box, toward the front. The speaker jacks are mounted in the back, and an additional ⅜" hole is drilled in the back to accommodate the line cord. The output transformer and filter choke are mounted at both ends inside the box.

(*Continued on page* 102)

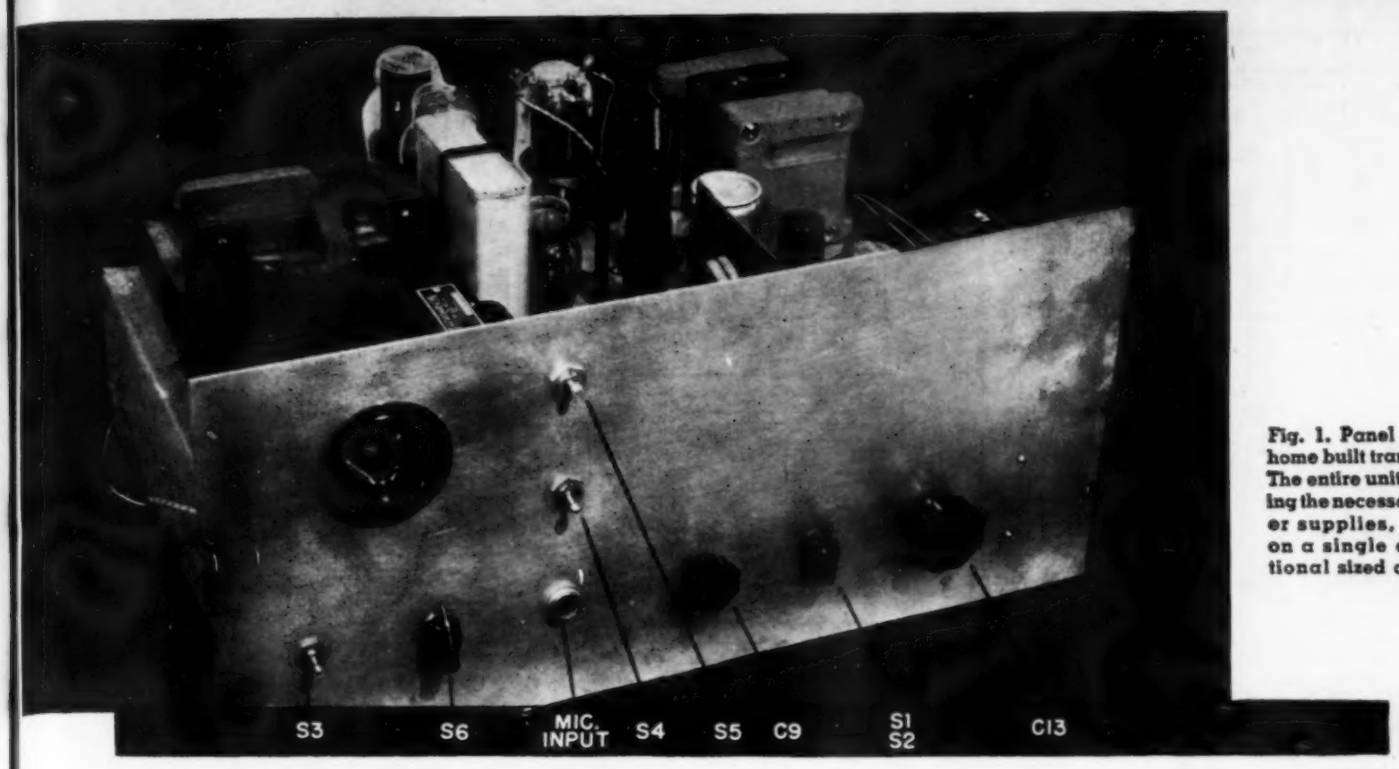


Fig. 1. Panel view of home built transmitter. The entire unit, including the necessary power supplies, is built on a single conventional sized chassis.

Compact 60-Watt Transmitter

By ROYDEN R. FREELAND, W5EMH

Complete construction details for a transmitter covering all amateur bands between 10-80 meters.

WITH the return of the amateur bands several months ago, a lot of hams were faced with the problem of getting a rig back on the air. Many amateur stations were broken up by the war when the operator was called into the Army, or moved to a new location; the old equipment being sold or too big for the new location.

The problem was to get a transmitter on the air that would be compact, versatile, and ready for operation on any of the bands when they became available. The transmitter shown in Fig. 1 is the author's solution to the problem.

The line-up of the transmitter is a 6J5 oscillator, 6AG7 buffer-multiplier, and an 815 final with an input power of 60 watts. Band-switching is used in the oscillator and buffer-multiplier stages while plug-in coils are used in the final to give coverage of all the amateur bands from 80 meters through 10 meters. A second 815 with its speech amplifier and driver stages supplies audio power for modulation. The entire transmitter, which is built on a single chassis, is powered from two power supplies.

Fig. 2 shows the schematic diagram of the transmitter. The oscillator is a modified Miller recommended for high-frequency crystals (harmonic crystals); however it works equally well on low frequency crystals. The oscillator operates with either an 80, 40, or 20 meter crystal according to the output frequency desired. For 10 meter operation either a 40 or 20 meter crystal may be used. The oscillator tank coil is tapped and switch S_1 shorts portions of the coil for coverage of the different bands. Only 150 volts is applied to the oscillator plate circuit which insures stable operation with low crystal current.

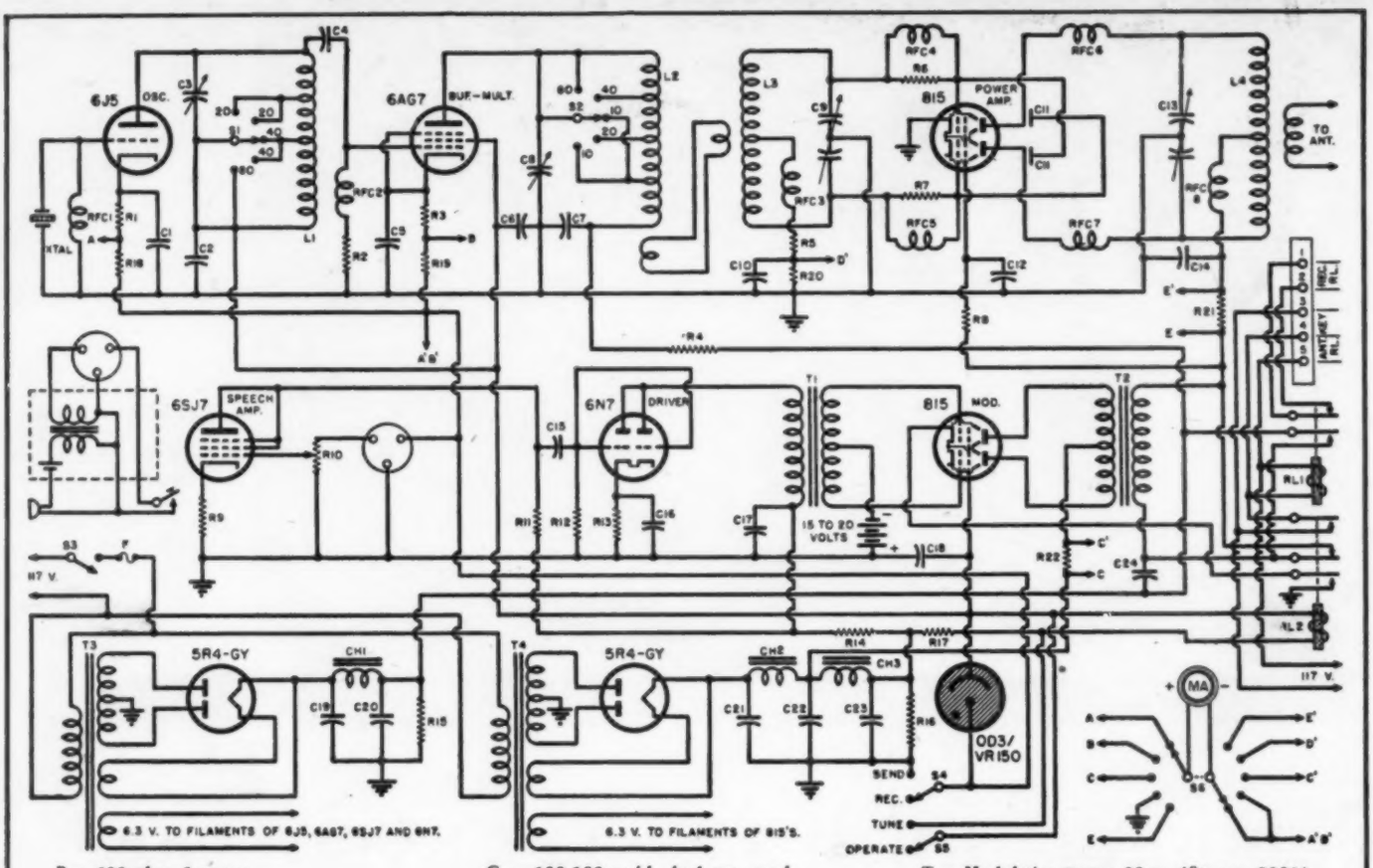
The output of the oscillator is capacitively coupled to the 6AG7 buffer-multiplier stage. This stage operates as a buffer, doubler, tripler, or quadrupler as required. The tank coil of the 6AG7 is tapped similarly to that of the oscillator and output frequencies are provided in the various switch positions as shown in Table 1.

In addition to the 10 meter band covered by positions 3 and 4, the 11 meter and 15 meter bands may also be covered in these positions when appropriate crystals are used. The 6AG7 has very low interelectrode capacitances and requires no neutralization when operating as a buffer amplifier. In addition, the 6AG7 requires very little driving power. Both cathode and grid-leak bias are used in this stage, the cathode bias limiting the plate current of the tube when no excitation is present. The screen grid voltage for the 6AG7 is regulated at 150 volts while 300 volts is applied to the plate. The output of the buffer-multiplier stage is link coupled to the balanced grid circuit of the final amplifier.

Table 1. Various output frequencies can be obtained by simply rotating switch S_1S_2.

Switch Position	Crystal Freq. in Meters	Output Freq. in Meters
1	80	80
2	40	40
3	40	10
4	20	20
5	20	10

The 815 push-pull final amplifier tube operates as a straight Class C amplifier on all bands. Plug-in coils are used in both the plate and grid circuits to cover the frequency range. As is the usual case with this tube, it is necessary to neutralize the stage. However, the neutralization is not critical. To eliminate the possibility of parasitic oscillations, the centers of the grid and plate tank coils are left floating and, in addition, parasitic chokes are inserted in the plate and grid leads. The 815 is plate and screen grid modulated for phone operation. The screen grid voltage is obtained through a dropping resistor from the 400 volt plate supply.



R_1—600 ohm, 1 w. res.
R_2—30,000 ohm, 1 w. res.
R_3—470 ohm, 1 w. res.
R_4—4000 ohm, 10 w. res.
R_5—13,000 ohm, 1 w. res.
R_6, R_7—10 ohm, ½ w. res.
R_8—15,000 ohm, 10 w. res.
R_9, R_{13}—900 ohm, 1 w. res.
R_{10}—500,000 ohm pot.
R_{11}—47,000 ohm, ½ w. res.
R_{12}—500,000 ohm, ½ w. res.
R_{14}—6500 ohm, 10 w. res.
R_{15}, R_{16}—40,000 ohm, 50 w. res.
R_{17}—5000 ohm, 10 w. res.
R_{18}, R_{19}, R_{20}, R_{21}, R_{22}—Meter shunts (see text)
C_1, C_2, C_3, C_6, C_{10}—.005 μfd., 400 v. cond.
C_3, C_5—75 μμfd. var. cond.
C_4—200 μμfd. mica cond.
C_7, C_{12}, C_{26}—.01 μfd., 600 v. cond.
C_9—100-100 μμfd. dual var. cond., .020" spacing
C_{11}—Neutralizing cond. (see text)
C_{13}—100-100 μμfd. dual var. cond., .030" spacing
C_{14}—.002 μfd., 1000 v. cond.
C_{15}—.05 μfd., 400 v. cond.
C_{16}—25 μfd., 50 v. elec. cond.
C_{17}, C_{18}, C_{25}—8 μfd., 450 v. elec. cond.
C_{19}—2 μfd., 600 v. elec. cond.
C_{20}, C_{21}, C_{22}—10 μfd., 600 v. elec. cond.
F—Line fuse
L_1, L_2—See text
L_3—Power amp. grid coil (B & W Type JCL)
L_4—Power amp. plate coil (B & W Type JVL)
RFC_1, RFC_2, RFC_3—2.5 mh., 125 ma. r.f. choke
RFC_4, RFC_5, RFC_6, RFC_7—Parasitic choke (See text)
RFC_8—2.5 mh., 250 ma. r.f. choke
S_1, S_2—Single-pole, 5 pos. ceramic sw. (ganged)
S_3, S_4, S_5—S.p.s.t. toggle sw.
S_6—Double-pole, 5 pos. ceramic sw.
T_1—Driver trans. Single plate to p.p. grids. 1.4 to 1 ratio. (Thordarson T-17DO3)
T_2—Modulation trans., 30 w. (Stancor 8001)
T_3—Power trans. 490-0-490 v. @ 200 ma.; 5 v. @ 2 amp.; 6.3 v. @ 3 amp. (UTC S-39)
T_4—Power trans. 400-0-400 v. @ 200 ma., 5 v. @ 2 amp.; 6.3 v. @ 3.5 amp. (Thordarson T13R16)
RL_1—110 v. a.c. relay with 1 normally closed and 1 normally open circuit
RL_2—Relay, 500 ohm coil with 2 normally open and 1 normally closed circuits
MA—Meter, full scale reading between 1 and 10 ma. (see text)
CH_1, CH_2—5 hy., 200 ma. filter choke (Thordarson 67C49)
CH_3—10 hy., 110 ma. filter choke (Thordarson 57C53)
1—Crystal (see text)
1—6J5 tube
1—6AG7 tube
2—815 tubes
1—6N7 tube
1—6SJ7 tube
2—5R4-GY tubes
1—OD3/VR150 tube

Fig. 2. Complete schematic of the transmitter. The microphone used is a single button carbon type with a push-to-talk switch. The microphone to grid transformer and the single flashlight cell for microphone current are built into a small steel case. Connections are made to the amplifier by means of a three contact plug and jack.

For 100 per-cent modulation of the final amplifier with 60-watts input, approximately 30 watts of audio is required. The 815 modulator is capable of supplying 40 watts of audio with a plate voltage of 400 volts and operating Class AB_2. Fixed battery bias is used, the bias being between 15 and 20 volts and adjusted so that the no-signal plate current is 20 ma. The screen grid voltage for the modulator is regulated at 150 volts. It is essential that the screen grid voltage remain constant with varying screen current if rated power output is to be received from the stage. The modulation transformer presents a load of 6000 ohms to the modulator tube, the secondary impedance of the transformer being 2500 ohms.

The 6N7 driver stage operates Class A_1 and is capable of supplying 400 mw. to the 815 modulator which is sufficient to drive the stage to rated output.

The 6SJ7 speech amplifier is connected as a triode and gives sufficient gain when using a carbon microphone. This tube can be connected as a pentode for use with a high-level crystal microphone.

All circuits of the transmitter are powered from two 400 volt power supplies. One power supply delivers plate and screen-grid voltage to the r.f. final amplifier and plate voltage to the buffer-multiplier stage. The second power supply delivers voltage to all of the other circuits. The oscillator plate, buffer-multiplier screen-grid, and modulator screen-grid circuits are connected to the second power supply through the regulator circuit made up of the regulator tube OD3/VR150 and resistor R_{17}.

One meter is used to measure the currents in the various circuits of the transmitter. Switch S_6 connects the meter to the circuit being measured. Five circuits are metered as follows: oscillator cathode, buffer-multiplier cathode, modulator plate, final grid, and final plate.

The control circuit of the transmitter is made up of three switches (S_3, S_4, and S_5) and two relays (RL_1 and RL_2). The control circuit functions in such a manner that the exciter stages can be tuned with no voltage being applied to the final; either phone or c.w. operation may be used; and push-to-talk action is available. In addition a circuit is brought out to terminals on the rear of the transmitter for operation of a receiver relay circuit. Also external connections are provided for operation of an antenna relay. For c.w. operation the key is placed in series with the coil of relay RL_1 which controls the high-voltage to the final amplifier. It was necessary to place RL_1 in series with the high-voltage lead instead of the cath-

SONAR— The Submarine's Nemesis

By C. G. McPROUD

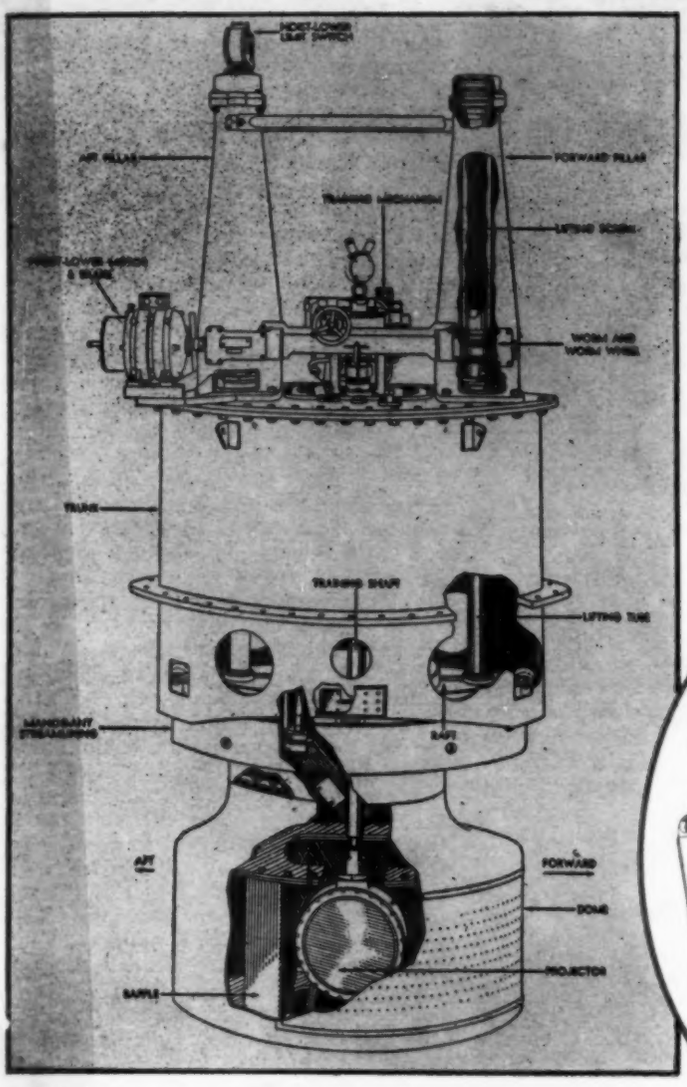


Fig. 1. Cutaway drawing of sonar dome and retracting gear.

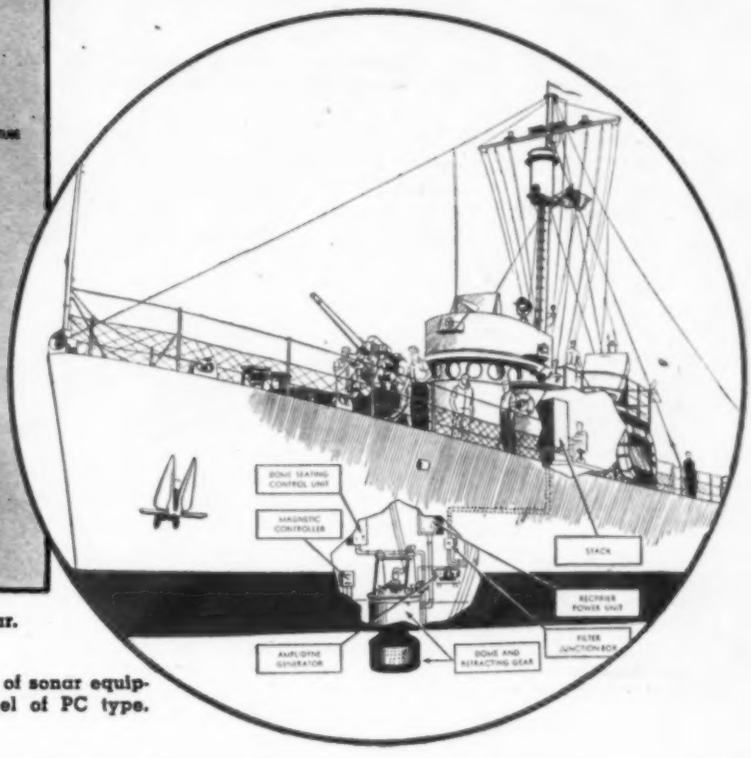


Fig. 2. General arrangement of sonar equipment in anti-submarine vessel of PC type.

The Navy has termed sonar a "major factor in the defeat of the U-boat and the winning of the Battle of the Atlantic" for the Allies.

"CONTACT—zero four zero—sixteen hundred yards," calls the sonar operator. Only seven words, but on an anti-submarine ship they are the signal for the start of a beehive of activity. Five principal performers bend every effort to keep a finger of sound on the enemy submarine until they can put on it a more effective "finger"—TNT. Two hundred other scared, sweating performers are tense with excitement, each doing his own job — readying depth charges, relaying telephoned orders, checking engine gauges, or executing any of the multitude of different jobs on a destroyer, DE or SC. All have only one objective—a successful attack.

The story of sonar cannot be told without acknowledging the efforts of those whose duty it was to handle a maze of electronic equipment. Radar has more glamor; loran is more spectacular; but the Navy calls sonar "a major factor in the defeat of the U-boat and the winning of the Battle of the Atlantic." Nine hundred and ninety-six enemy submarines were sunk during the war. The majority of them were detected by the sonar equipment and attacked on the basis of information supplied by it.

Informed readers are almost as familiar wth radar as they are with radio itself. Sonar has received less publicity in the technical press, yet the methods employed in detecting unseen submarines are just as fascinating as those used to detect unseen airplanes.

Sonar principles are similar to radar —the time is measured between the transmission of a pulse and the reception of an echo bouncing back from the target. Simple as that. But in sonar, the signal is not an electrical wave—it is a sound wave at a frequency between 18 and 24 kc. The transmitter is a typical master oscillator power amplifier with the output feeding a "projector" which converts the electrical signal into supersonic mechanical vibrations.

Projectors of various types are used. In the magneto-striction type, several hundred nickel tubes are imbedded in a one-inch thick diaphragm. Each tube is surrounded by a coil of wire which carries the signal voltages. Fig. 8 shows the construction of the projector used with the QCQ-2 equipment. The varying magnetic field induced by the coil causes the tubes to shorten and lengthen alternately, and this activity causes the diaphragm to vibrate. The resonant frequency of the diaphragm is very sharp, the response being down 50 per-cent at a frequency two per-cent off the peak. Such selectivity results in a high signal-to-noise ratio.

Crystal projectors employ a large number of Rochelle salt or ammonium-

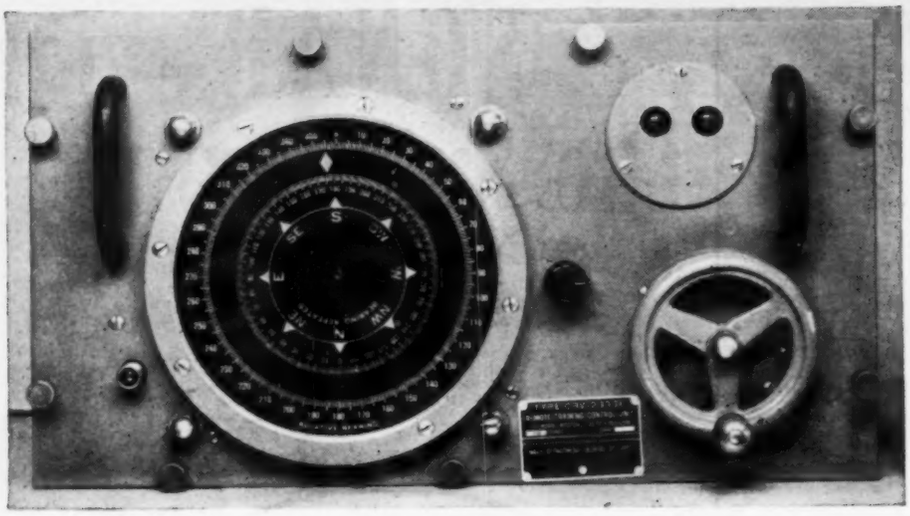


Fig. 3. QCQ-2 training control panel, showing indicator for true and relative bearings, and handwheel for control of projector rotation.

dihydrogen-phosphate (ADP) crystals arranged in rows. Each has two electrodes, and they are connected in parallel. The output of the driver amplifier is fed to these crystals, and the vibration caused by the piezoelectric action is transmitted to the sea water through castor oil surrounding the crystal blocks. A sound-transparent rubber cover keeps the oil in, the water out. The ADP crystal, developed during the war by *Bell Telephone Laboratories* has the same piezoelectric properties as Rochelle salt, but is less subject to rupture from high signal potentials, and may be worked to higher temperatures. Crystal projectors are about 80 percent efficient, whereas magneto-striction projectors have an efficiency of around 10 per-cent. A comparison of these figures would seem to indicate that the crystal projector would be used exclusively, but the added advantage of the greater selectivity is of more importance than efficiency. Recently developed projectors employ a tuned back-plate for the crystal array, with some increase in selectivity, but not to the extent possible in the magneto-striction type.

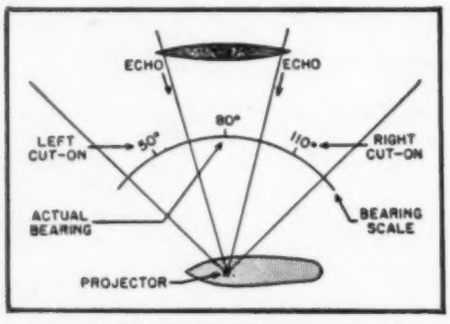


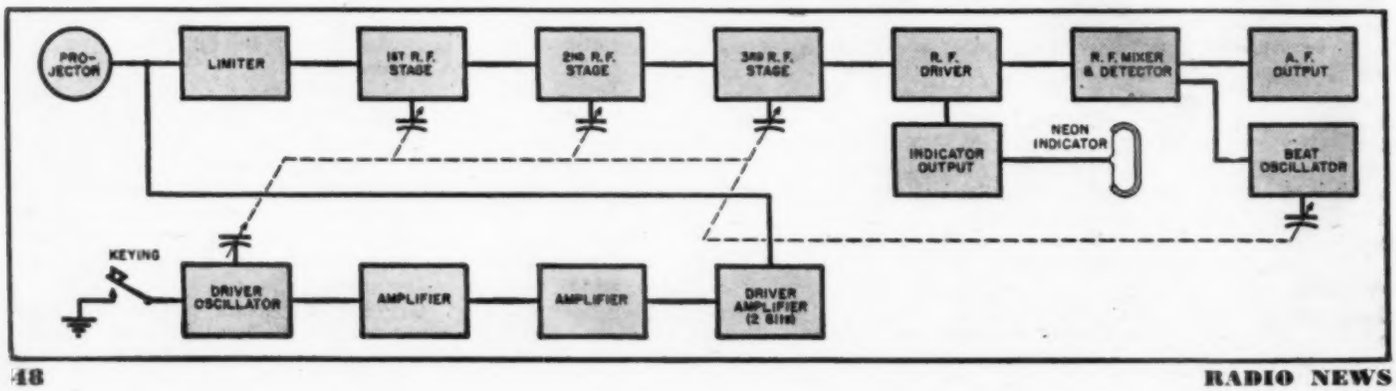
Fig. 4. Determining bearing of target by midpoint between two cut-on points.

A typical sonar system consists of a transmitter to furnish the electrical output signal, a receiver to amplify the weak echoes, an indicator to measure the time from the transmission of the pulse or "ping" to the reception of an echo, the projector, and means for rotating the projector under water. The larger anti-submarine ships have the projector mounted in a retractable streamlined dome, located about 30 feet back from the bow. This dome and retracting gear, as it is called, is shown in detail in the drawing of Fig. 1. The illustration also shows the location of the dome and retracting gear aboard ship.

The dome proper is a streamlined structure with a .020" stainless steel sound window, extending on each side about 135 degrees from the forward end. This window is spot welded to expanded metal reinforcing. The entire structure is mounted in an opening in the keel, with the bottom of the dome in the retracted position flush with the bottom of the hull. The dome is carried on a steel raft, which is raised and lowered by means of the lifting screws in the two pillars. The mahogany streamlining is shaped to the contour of the hull to reduce turbulence when the dome is lowered. The projector is carried on its shaft, which is rotated by the training mechanism. Since the top of the dome is open to the water, the dome is flooded with water at all times. In the retracted position, the top of the dome is seated against a gasket, so that the projector may be removed for necessary maintenance while the ship is waterborne.

We have mentioned briefly the transmitter, or "driver," as it is called in sonar. In the QCQ-2 equipment of *RCA* manufacture, the output stage consists of a pair of 811's in class B, with two more 811's as rectifiers. The driver amplifier for this equipment is capable of an output of 400 watts, this power being concentrated in a pulse of one-quarter second or less, transmitted at six-and-a-quarter-second intervals. These pulses are inaugurated by a mechanical keying arrangement which is part of the "indicator." This indicator is used to measure the time required for the sound wave to travel to the target and be reflected back. Since sound travels at a speed of approximately 4800 feet per second in salt water, and since it must make the round trip from the projector to the target and back, it is seen that the time required for the sound wave to "range" an object 1600 yards distant is two seconds. A target at 400 yards requires a half second for the round trip. These are relatively long times—compared to radar, for example—so a simple arrangement will suffice as an indicator. Some equipment uses a disc making one revolution in 1¼ seconds for targets closer than 1000 yards, and a slower rate of revolution in 6¼ seconds for 5000 yard maximum. When the target is at a greater distance than 5000 yards, the keying is made to occur at every other revolution of the disc. A synchronous motor drives the disc which moves behind two scales, calibrated in 0-1000 and 0-5000 yards, around its circumference. A neon light is mounted behind a slit in the disc. As the slit passes the scale "zero," cam actuated contacts energize the oscillator, and a pulse is emitted from the projector. This pulse travels horizontally through the water. If a submarine, reef, or

Fig. 5. Block diagrams illustrating functional operation of RCA QCQ-2 sonar equipment.



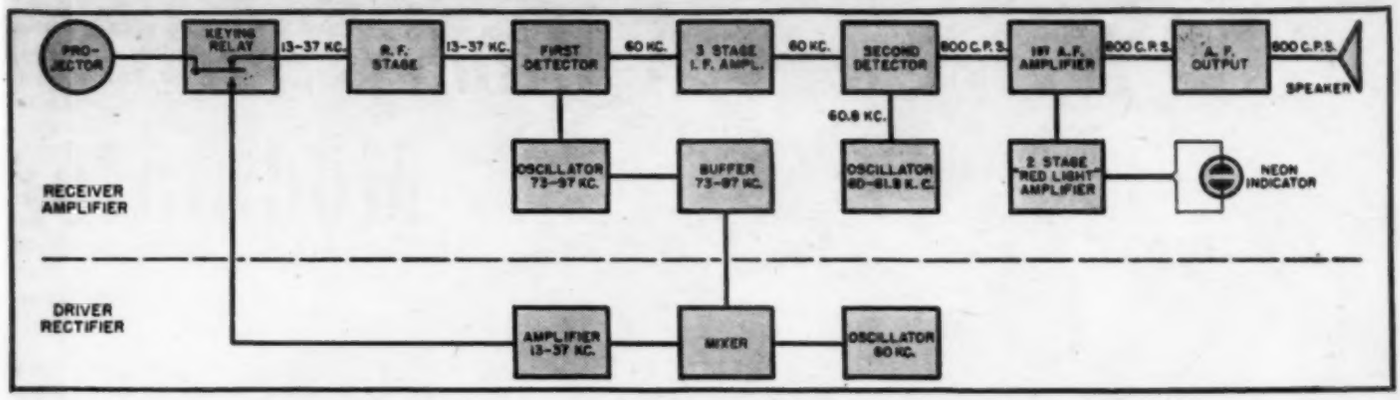


Fig. 6. Block diagram of Submarine Signal Company's WCA-2 sonar equipment. Tuning receiver also tunes driver rectifier, so that both receiver and transmitter are always tuned to the same frequency.

school of fish is in the path of the sound beam, it is reflected back as an echo, received by the projector acting as an underwater microphone, amplified by the receiver, and the output signal causes a flash of the neon tube. During this time, the disc travels a distance proportional to the range of the target, and the position on the scale of the echo flash indicates the range.

Another type of indicator is that used in the QCQ-2 equipment. The principle of operation is the same, although the mechanical construction is considerably different. The flashes of light from a long neon tube are observed through a hole in a thin steel belt, motor-driven at a constant speed.

Both t.r.f. and superheterodyne circuits are used in sonar receivers. Equipment manufactured by the *Submarine Signal Company* uses the superheterodyne, consisting of an r.f. stage, local oscillator, first and second detectors, and i.f. and a.f. amplifiers, shown in block schematic form in Fig. 6. The detectors are copper oxide "varistors," so called from their use as variable resistors. With an i.f. of 60 kc., it is necessary for the oscillator to be tuned simultaneously with the r.f. stage to a frequency 60 kc. above that of the signal. A three-stage i.f. amplifier with variable selectivity feeds another varistor as the second detector, where it is mixed with a heterodyne oscillator frequency of 60.8 kc., resulting in an audio tone of 800 c.p.s. This audio signal is fed through separate amplifiers to the neon indicator, and to a loudspeaker. The audible signal is used to indicate the relative motion of the target with respect to the ranging vessel by means of the Doppler effect.

For an explanation of this, consider the pitch of a locomotive whistle as a train approaches, passes, and recedes from a listener. As the train is approaching, the pitch is higher than when it is passing, and still lower as the train recedes. Sound waves from the approaching train have, besides their own velocity, the additional velocity imparted by the movement of the train; hence, more vibrations reach the ear in a given time, causing a sound of higher pitch. The reverse is true as the train recedes.

Applying this principle to sonar, it is seen that the echo from a stationary object will have the same pitch as the reverberation, both of which are heard by the operator. (Reverberation is the sound reflected back to the projector from air bubbles and infinitesimal particles in the water.) But if the target is moving toward the ranging vessel, the echo gets an extra impetus from this motion, and the pitch is higher. A target moving away will return an echo of lower pitch. Thus the operator can judge the target movement.

Returning to a description of the equipment, the receiver used by the QCQ-2 equipment employs a t.r.f. circuit. A five-gang condenser tunes three r.f. stages, a heterodyne oscillator tracking 800 c.p.s. below the signal frequency, and another oscillator tracking with the r.f. stages. This circuit is the master oscillator for the driver, and two additional stages following the oscillator tube provide enough signal voltage to actuate the driver amplifier. Fig. 5 shows the entire system in block form. With this equipment, the operator can tune

(*Continued on page* 139)

Fig. 7. QCQ-2 sonar "stack." From top to bottom, receiver-indicator-driver oscillator, training control, and driver amplifier.

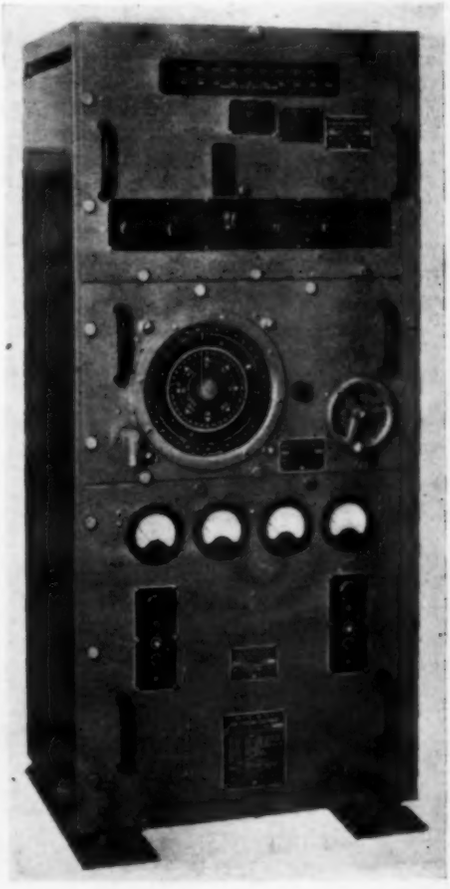
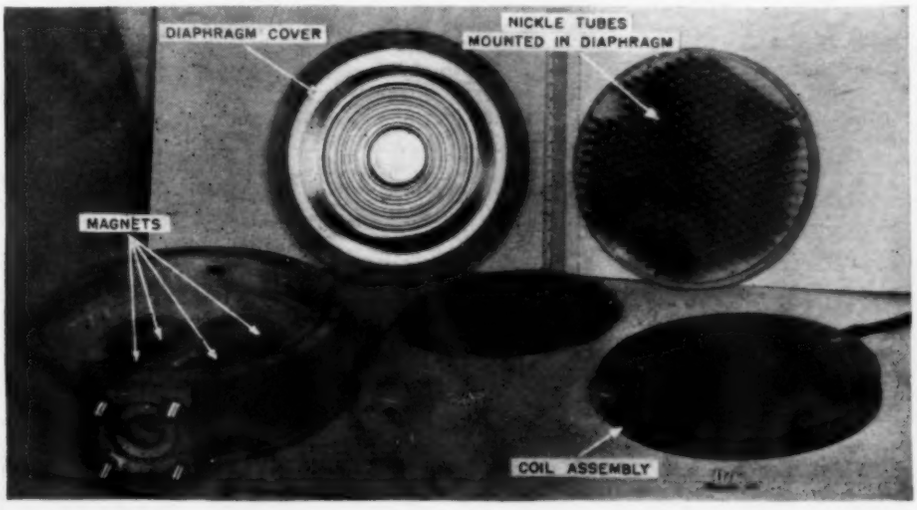


Fig. 8. Disassembled view of QCQ-2 magnetostriction projector.



A Handy 20-Watt Modulator

Fig. 1. Top-front view of completely home-built modulator.

By RUFUS P. TURNER, W1AY
Consulting Eng., RADIO NEWS

Construction details for an inexpensive modulator that can be used with most types of amateur rigs.

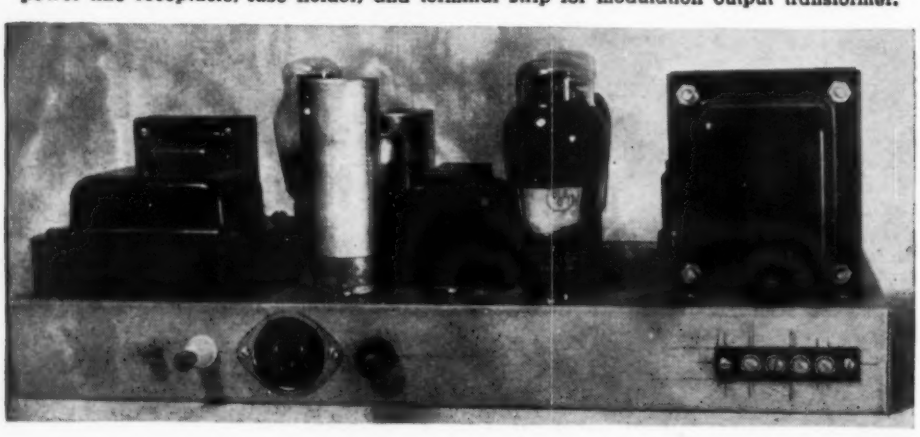
THOSE choice, new ultra-high frequencies certainly are inviting. The thrill of making circuits oscillate or amplify at hundreds —and even thousands of megacycles and of sending out beams with antenna arrays you can hold in your hand is not easily passed up. Lots of hams already are exploring our new territory and firing up on our returned u.h.f. bands, as well. We have a lot of catching up to do.

For some indistinct reason, the usual amateur procedure is to spend days on end developing a new u.h.f. rig, with no thought as to audio, and upon completing the job to discover that almost as much more time must be spent building a modulator. A steady carrier is none too useful! Few hams keep on the shelf a ready-built and rarin' to go audio unit suitable for modulating experimental u.h.f. rigs. Heretofore, your author has been no exception.

The ham who intends to do any amount of experimenting with u.h.f. gear will not question the advisability of keeping a small modulator on hand. Fortunately, most experimental, fixed-station u.h.f. transmitters run plate inputs of 40 watts or less. A complete, self-powered modulator delivering 20 watts or so and accommodating any of the usual amateur microphones will therefore be adequate for amplitude-modulating these rigs 100 per-cent. In a large number of cases, the parts for such a modulator may be found in the junk box. But the unit will not be expensive even if built "from scratch."

The modulator described in this article is simple and foolproof and was built primarily for experimental u.h.f. use. Between experiments, it has been used successfully as a speech amplifier to drive a zero-bias modulator in the big rig (through a coupling transformer for matching a 500-ohm line to zero-bias class B grids) and is recommended as standard equipment for other u.h.f. experimenters. It has enough over-all gain to handle amateur crystal and dynamic microphones and enough wallop to modulate the low-powered gear most likely to be used in u.h.f. experiments. The unit is inexpensive and straightforward in design and requires no coddling to get going or to keep in top operating condition.

Fig. 2. Rear chassis view. From left to right along chassis flange are: two relay contacts, power line receptacle, fuse holder, and terminal strip for modulation output transformer.

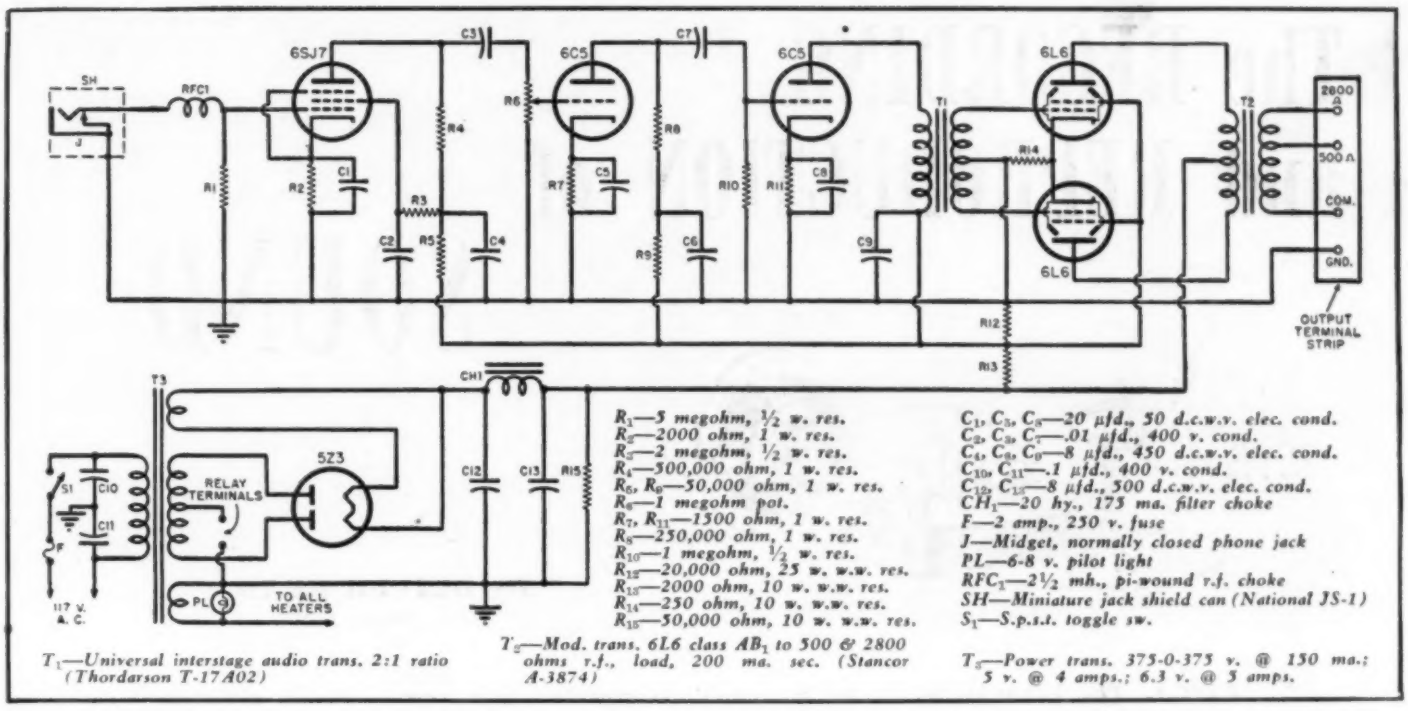


General Description

The power output of the modulator is approximately 24 watts. The tube lineup is 6SJ7-6C5-6C5-push-pull 6L6's, class AB_1. The power supply is built on the same chassis, making the unit completely single-packaged. Over-all gain is approximately 100 db. With the layout shown in Fig. 5, hum level is low enough to be of no practical consequence in communication work.

External views of the unit are given in the photographs, Figs. 1 and 2. Fig. 4 is an under-chassis view. These photographs, together with the layout drawing (Fig. 5) show completely the structural aspects of the modulator.

The output transformer employed by the author provides two modulating impedances—500 ohms and 2800 ohms. Lack of additional impedances has caused little trouble, however, since it has been easy to adjust the



R_1—5 megohm, ½ w. res.
R_2—2000 ohm, 1 w. res.
R_3—2 megohm, ½ w. res.
R_4—300,000 ohm, 1 w. res.
R_6, R_9—50,000 ohm, 1 w. res.
R_8—1 megohm pot.
R_7, R_{11}—1500 ohm, 1 w. res.
R_8—250,000 ohm, 1 w. res.
R_{10}—1 megohm, ½ w. res.
R_{12}—20,000 ohm, 25 w. w.w. res.
R_{13}—2000 ohm, 10 w. w.w. res.
R_{14}—250 ohm, 10 w. w.w. res.
R_{15}—50,000 ohm, 10 w. w.w. res.

C_1, C_3, C_5—20 μfd., 50 d.c.w.v. elec. cond.
C_2, C_4, C_7—.01 μfd., 400 v. cond.
C_6, C_8, C_9—8 μfd., 450 d.c.w.v. elec. cond.
C_{10}, C_{11}—.1 μfd., 400 v. cond.
C_{12}, C_{13}—8 μfd., 500 d.c.w.v. elec. cond.
CH_1—20 hy., 175 ma. filter choke
F—2 amp., 250 v. fuse
J—Midget, normally closed phone jack
PL—6-8 v. pilot light
RFC_1—2½ mh., pi-wound r.f. choke
SH—Miniature jack shield can (National JS-1)
S_1—S.p.s.t. toggle sw.

T_1—Universal interstage audio trans. 2:1 ratio (Thordarson T-17A02)

T_2—Mod. trans. 6L6 class AB_1 to 300 & 2800 ohms r.f., load, 200 ma. sec. (Stancor A-3874)

T_3—Power trans. 375-0-375 v. @ 150 ma.; 5 v. @ 4 amps.; 6.3 v. @ 3 amps.

Fig. 3. Schematic diagram of 20-watt modulator. The circuit is simple and no trouble should be experienced in duplicating it.

d.c. plate input of various u.h.f. oscillators and amplifiers to correspond to an impedance of 2800 ohms. The 500-ohm output has been used for cathode modulation and also occasionally to feed the 500-ohm primary winding of an external multimatch modulation transformer or the primary of a 500 ohm to push-pull grids transformer in a *zero bias* modulator.

Operating as it does without degeneration, distortion in the modulator is tolerable. However, an individual builder may, if he desires, add degenerative feedback to the push-pull 6L6 stage with a slight decrease in power output.

Since, for experimental reasons, the author desired complete manual control of gain, no automatic modulation circuit was included. But an individual builder may obtain an a.m.c. simply by rectifying a portion of the audio output (e.g., with a capacitance-coupled 6H6 tube or crystal diode) and feeding a portion of the rectified voltage, regulated by means of a potentiometer, back through a resistance-capacitance filter to the suppressor of the 6SJ7 tube. The suppressor must, of course, first be disconnected from the cathode terminal.

Electrical Details

The complete circuit diagram of the modulator is given in Fig. 3.

The 6SJ7 high-gain input stage provides the highest voltage gain. The two succeeding 6C5 stages each have medium gain. The push-pull 6L6 stage is self-biased and its screen voltage is supplied by the voltage divider R_{12}-R_{13}. Decoupling filters, comprised of 50,000-ohm resistors R_8 and R_9 and 8 μfd. capacitors C_4 and C_6, insure stable operation of the first two amplifier stages.

The self-contained power supply is a conventional capacitor-input circuit comprised of transformer T_3, the 5Z3 rectifier tube, filter section CH_1-C_{12}-C_{13}, and bleeder resistor R_{15}. The power supply components are mounted on the end of the chassis farthest from the amplifier input stages, in order to minimize hum.

Radio-frequency feedback, unusually troublesome at ultra-high frequencies, is discouraged by complete shielding of the microphone jack, *J*, with a small shield can (See *SH* in Fig. 3) and inclusion of a 2½ millihenry r.f. choke, RFC_1. All metal tube envelopes are grounded by connecting the No. 1 socket pins to chassis through the shortest possible leads. If metal 6L6 tubes are used in the output stage, their envelopes *must* be grounded in this same manner.

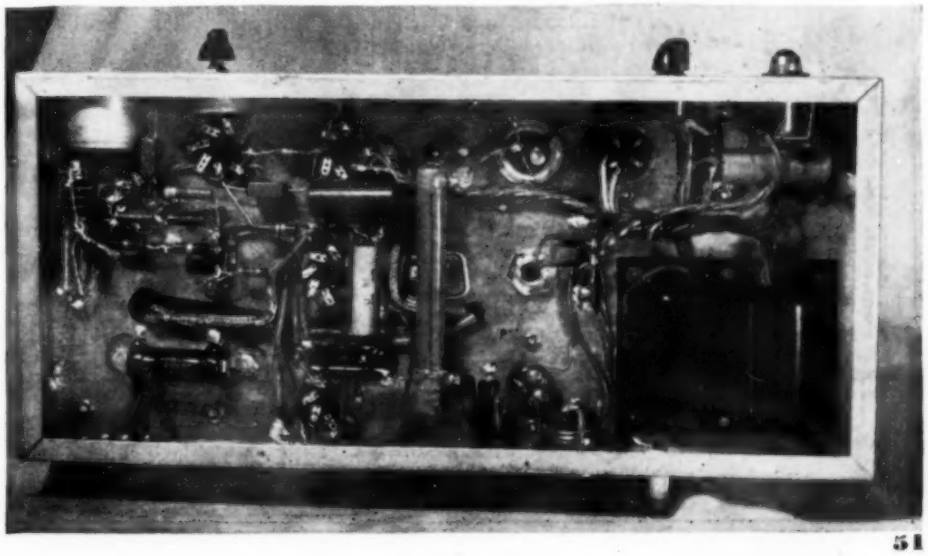
The 1-megohm potentiometer R_8 is the amplifier gain control. The under-chassis view (Fig. 4) shows this control mounted as close as possible to the control grid terminal of the second 6C5 socket.

All resistors except R_{12}, R_{13}, R_{14} and R_{15} are small-sized carbon units. Each resistor in the latter group is a 10 watt wire-wound unit except R_{12} which is 25 watts wire-wound.

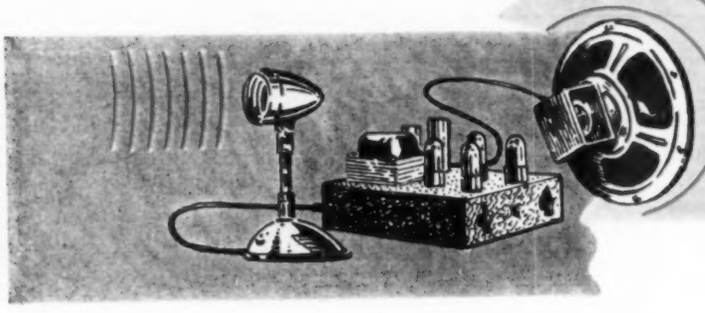
Transformer T_2 was selected because its two output impedances satisfied most requirements. The author has found it easy to adjust the plate input of various u.h.f. oscillators and amplifiers to a value corresponding to 2800 ohms. Thus, a rig operated at 300 plate volts will offer an impedance of 2800 ohms when its plate current is adjusted to 107 milliamperes, a 350-volt oscillator or amplifier shows 2800 ohms at 125 plate mils, etc., etc. (Impedance in ohms equals plate volts divided by plate *amperes*.) The 500-ohm winding is almost uni-

(*Continued on page* 161)

Fig. 4. Under-chassis view shows wiring and position of component parts.



The RECORDING and REPRODUCTION of SOUND



By OLIVER READ
Editor, RADIO NEWS

Part 1. The behavior of sound waves — introduction to a new series of articles covering the history, development, and applications of all currently known methods employed for the recording and reproduction of sound. Mechanical, electrical, and electronic methods will be covered, including sound on wire, disc, tape, film, etc.

TO FULLY understand the many problems which enter into the recording and reproduction of sound, we must first take into consideration the basic concept of sound. We must understand and fully appreciate the characteristics of sound or we cannot apply satisfactory techniques to obtain a true facsimile of the original sounds we expect to reproduce.

Webster defines *sound* as follows: "Sensation due to stimulation of the auditory nerves and auditory centers of the brain, usually by vibrations transmitted in a material medium (commonly air) affecting the organ of hearing—vibration energy which occasions such a sensation. Sound is propagated by progressive longitudinal vibratory disturbances (sound waves)." Thus, it becomes apparent that the source of sound lies in the realm of physics, while the effect of sound is a physiological consideration. The engineering of sound consists of controlling the cause so as to produce the desired effect.

The theory of *sound waves* may be explained in simplified form thusly: If a small stone is dropped into a pool of still water, waves will be set up which will travel in all directions away from the point of impact. If our original stone were small in physical size, only waves small in height would result. However, if a large stone were dropped into the still water, we would discover that we have generated waves having a greater height. The up and down movement of the waves represents the *amplitude* or the intensity of the waves.

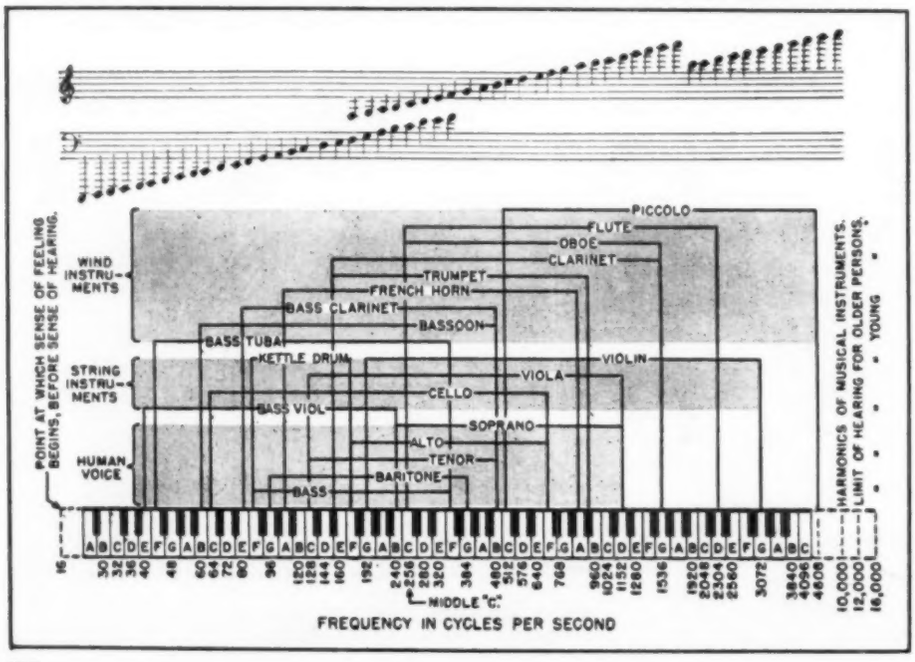
Differing from the behavior of water waves, sound particles of air do not move up and down and across in the pattern in which waves move but all move in the same direction. These particles of disturbed air literally bump one another as they travel through space. The air, therefore, is alternately compressed and rarefied.

The number of waves passing any fixed point per second represents the *frequency* or number of waves per second. Therefore, the *frequency* depends upon the number of waves traveling past one spot during an interval of one second. If we tie a string to a stone which is immersed in still water and move it up and down at the rate of 100 times per second, we will send out waves from the point of impact at the rate of 100 per second. In the study of acoustics we refer to *frequency* in terms of cycles per second, abbreviated c.p.s.

Now suppose we took a large stone and moved it up and down very slowly in and out of the water, we would then set up waves at a lower frequency but, due to the greater displacement of the water by the object, we would create waves of greater amplitude.

The top of the wave is referred to as the *crest*, while the bottom is known as the *trough*. One *cycle*, as far as one wave is concerned, would be one complete wave beginning from its normal still point, building up to a crest, passing again through its still point,

Fig. 1. Frequency range of musical instruments and those covering the human voice.



down to the lowest point, the trough, and its return to its normal position. See Fig. 4D.

Sound waves are not limited to but one frequency. In fact the speaking voice is made up of a variety of *complex waves.* These are continually varying in both frequency and amplitude. In other words, if we raise our voices in *pitch,* we are actually increasing the *frequency* and the *louder* we talk, the greater will be the *amplitude* of the sound waves sent out by our speaking mechanism.

All sound waves are composed of frequency, intensity, periodicity, and waveform.

1. *Frequency* is the speed of vibration or number of complete cycles per second. Frequency also determines pitch. If we double the speed of vibration, we raise the pitch one octave. For example, a note having 1000 vibrations or cycles per second would be raised by one octave if the frequency were doubled to 2000 c.p.s.

2. *Intensity* is the amplitude or power of vibration. Intensity therefore determines the loudness of a sound. If the pressure of a sound wave is doubled in intensity, we increase the power by about 3 decibels. The *decibel* is a ratio of power and not a quantity.

In the behavior of sound waves various ranges of intensities and pressures are so great that it is necessary to have some means which will conveniently measure volume or amplitude. The *decibel* is a unit used for expressing the magnitude of a change in either a sound level or a signal level. One decibel is the amount that the pressure of a pure sine wave tone must be changed in order for the change to be just barely detectable by the average human ear. The amount of change in power level expressed in decibels is equal to ten times the common logarithm of the ratio of the two powers. db. $= 100 \log_{10} P_1/P_2$.

3. *Periodicity* is the lack of, or the existence of, rhythm in sound. Therefore, musical sounds are *periodic,* while street noises, the jingle of keys on a chain, etc. are *non-periodic.*

4. *Waveform* is a direct pattern of vibration. Most fundamental sound waves are modified by secondary vibrations. The *timbre* of sound is determined by the waveform. Thus it is possible to distinguish particular notes played on various musical instruments such as the violin and the flute.

Distortion

If a microphone, radio tuner, pickup, amplifier or speaker is incapable of reproducing a true picture of the original sound waves, *distortion* will occur. This distortion may come from either mechanical or electrical defects in the system. *Mechanical distortion* may be caused from such conditions as having a needle in a phonograph pickup move because it has not been tightened thoroughly by means of the needle set screw. In other words, vibrations set up within the pickup could not transmit or move the needle in perfect cadence with the original electrical vibrations. The needle would be permitted to move freely and to follow vibrations of its own choice instead of moving in perfect unison with the armature in the pickup.

Many reproducer (loudspeaker) cones vibrate at some particular frequency not found in the music that is fed to the speaker for reproduction. The resulting buzzing effect would be a form of *mechanical distortion.* The above illustrations are typical but many others may be encountered throughout the equipment if care is not exercised to adjust each and every part which might cause mechanical distortion.

Generally speaking, a sound is said to be distorted when the waveform is altered in transmission or when the intensity of any frequency is suppressed or exaggerated out of its natural proportions.

Electrical distortion is caused by the inability of the microphone, amplifier or speaker to give a true reproduction (facsimile) of frequency. For example; the delicate diaphragm on a microphone may become warped from excessive heat, etc. As pressure from the sound waves strikes this distorted diaphragm, the resulting currents

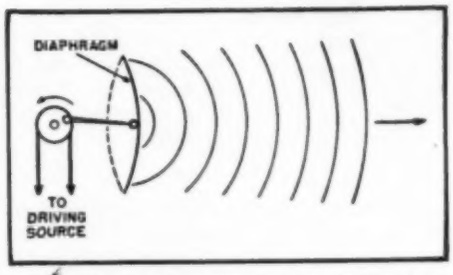


Fig. 2. Sound waves created by the movement of a mechanically-driven diaphragm.

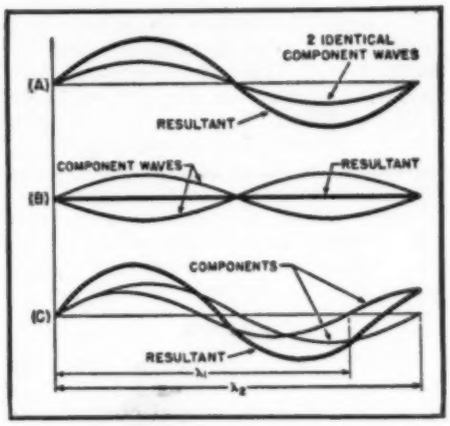
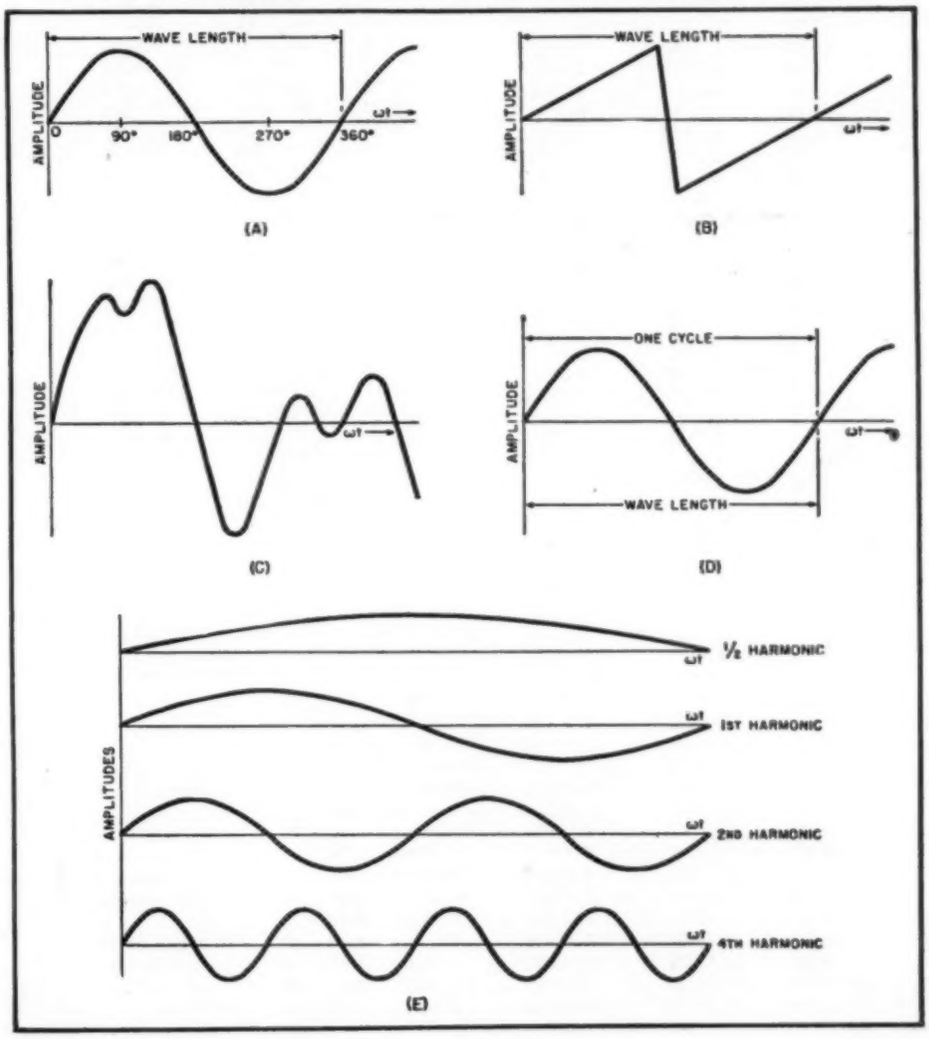


Fig. 3. The combination of two harmonic waves vibrating at the same frequency.

Fig. 4. Illustrating the characteristic behavior of wave motion: (A) sine or cosine, (B) periodic, (C) random, (D) one cycle and (E) harmonics.



would become distorted. There are many forms of electrical distortion. A poorly designed amplifier, overloaded audio stages, impedance mismatching and improper biasing will all result in electrical distortion.

The Ear

There are three main divisions to the human ear: (a) The outer ear, which is made up of the visible portion of the ear and the canal which is not visible. (b) The middle ear, which is the receiver for sound approaching the eardrum and the conducting media for sounds through a chain of three small bones (the ossicles), to the inner ear. (c) The inner ear is the delicate container filled with fluid in which is immersed the nerve ends which perceive sound and which also transmit messages to the brain. The part of the inner ear that perceives sound is called the cochlea. There is still another part of the inner ear in the form of semi-circular canals which give us our sense of balance.

Speech

Speech has a frequency range of from approximately 100 to 8000 c.p.s. There are three principal components to speech. They are listed as follows:

1. The *fundamental* range (or voice). 100 to 400 c.p.s.
2. The *vowel* range. 300 to 2500 c.p.s.
3. The *consonant* range. 2000 to 8000 c.p.s.

The above are approximate ranges and do not necessarily indicate the proportion of sounds that occur in each division. Sounds having very low frequencies possess the most power and result in naturalness and apparent loudness. High frequency sounds provide intelligibility. If we eliminate all sounds below 1000 c.p.s., we take but little from the clarity of the sound, but we do notice that the sound appears to be unnatural. However, if we eliminate sounds above 1000 cycles, we find that the speech is unintelligible but, as far as volume is concerned, there is little, if any, apparent change.

Speech may be considered as a series of *periodic* sound waves, emitted in a certain sequence. Association of particular sound sequences with particular ideas is the distinguishing feature between speech and noise. The so-called "scrambled" speech systems serve as an excellent illustration of this point. In such a system, spoken sounds are distorted by specially designed circuits and then transmitted in the distorted form. The receiver must have a rectifying circuit to convert the wave impulses back to their original undistorted form rendering it intelligible to the human ear.

Music

That sound we choose to call music consists of a sequence of single tones or a sequence of several tones played in unison. Pure single tones are harmonic in waveform and the key or pitch is determined by the frequency (with certain modification to be discussed later). The scale is an ascending series of tones with definite frequency intervals. Fig. 6 shows a portion of a standard piano keyboard for one octave on each side of middle C. The frequencies noted represent a so-called tempered scale which divides an octave into twelve equal intervals. The relative frequencies of the tempered scale (omitting sharps and flats) are shown below for one octave:

Key	Relative Frequency
C	1.000
D	1.122
E	1.260
F	1.325
G	1.498
A	1.682
B	1.887
C	2.000

The combinations of two or more tones make up a periodic composite sound. Here again the psychological phase of music shows up, for if the new sound is pleasing to the ear, it is called harmonious. If, on the other hand, the sound is irritating, the combination of tones is said to be in discord.

Frequency Range

If a tone is maintained at a constant intensity but its frequency is raised and lowered, high and low frequency points will be reached beyond which there will be no sensory perception by the ear. Generally this *frequency range* extends from 30 to 16,000 c.p.s. The frequency range for conversational speech is from about 100 to 8000 c.p.s., as mentioned previously. In terms of power, conversational speech will vary over about 40 db. and the intensity of the loudest sound will be about 10,000 times that of the weakest.

A large symphony orchestra, with instruments producing an abundance of bass notes and overtones extends over practically the entire frequency range of the ear—30 to 16,000 c.p.s. The over-all volume range of a symphony orchestra from the softest passages through the loudest passages and peaks runs about 70 db. or an intensity range of 10,000,000 times.

Reproducing systems for highest fidelity should have a frequency range that is uniform from about 30 to 16,000 c.p.s. and a volume range of 70 db.

Of equal importance, the original sounds must be reproduced at the same power levels as were present in

(*Continued on page* 88)

Fig. 5. Conversion chart for standard 500 ohm db. meter across impedances from 2-4000 ohms.

POWER LEVEL (db.)	VOLTS 500 OHM LINE	POWER WATTS 0 db. = 6 mw.
−20	0.1730	0.00006
−19	0.1990	0.00007
−18	0.2180	0.00009
−17	0.2340	0.00011
−16	0.2730	0.00015
−15	0.3000	0.00018
−14	0.3390	0.00023
−13	0.3890	0.00030
−12	0.4450	0.00039
−11	0.4860	0.00047
−10	0.5477	0.00060
− 9	0.6145	0.00070
− 8	0.6895	0.00090
− 7	0.7737	0.00110
− 6	0.8681	0.00150
− 5	0.9740	0.00180
− 4	1.0928	0.00230
− 3	1.2262	0.00300
− 2	1.3758	0.00370
− 1	1.5437	0.00470
0	1.7321	0.00600
+ 1	1.9434	0.00750
+ 2	2.1805	0.00950
+ 3	2.4466	0.01190
+ 4	2.7451	0.01500
+ 5	3.0801	0.01890
+ 6	3.4559	0.02380
+ 7	3.8776	0.03000
+ 8	4.3507	0.03800
+ 9	4.8680	0.04740
+10	5.4772	0.06000
+11	6.1600	0.07590
+12	6.8100	0.09480
+13	7.7368	0.11970
+14	8.7100	0.15070
+15	9.7400	0.18970
+16	10.9285	0.23880
+17	12.2620	0.30070
+18	13.7578	0.37850
+19	15.4369	0.47660
+20	17.3205	0.60000
+21	19.4340	0.75530
+22	21.8050	0.95090
+23	24.4660	1.19710
+24	27.4510	1.50710
+25	30.8010	1.89740
+26	34.5590	2.3886
+27	38.7760	3.0071
+28	43.5070	3.7857
+29	48.8160	4.7660
+30	54.7720	6.0000
+31	61.4550	7.5535
+32	68.9540	9.5093
+33	77.3680	11.9716
+34	86.8080	15.0713
+35	97.4000	18.9747
+36	109.2850	23.8865
+37	122.6200	30.0710
+38	137.5820	37.8570
+39	154.3690	47.6600
+40	173.2050	60.0000
+41	194.3400	75.5350
+42	218.0500	95.0930
+43	244.6600	119.7160
+44	274.5100	150.7130
+45	308.0100	189.7470
+46	345.5900	238.8650
+47	389.0700	300.7100
+48	435.6000	379.5000
+49	487.0100	474.3700
+50	547.7200	600.0000
+51	616.0300	759.0000
+52	688.7400	948.7500
+53	770.4000	1185.9400
+54	871.2000	1518.0000
+55	974.0300	1897.5000

Impedance		DB.
4000 ohms	Subtract	9
2000 ohms	Subtract	6
600 ohms	Subtract	1
500 ohms	.....	0
250 ohms	Add	3
24 ohms	Add	13
15 ohms	Add	15
10 ohms	Add	17
8 ohms	Add	18
6 ohms	Add	19
5 ohms	Add	20
4 ohms	Add	21
2.5 ohms	Add	23
2 ohms	Add	24

$E = \sqrt{WZ}$

where:

E = a.c. volts across load

Z = loaded line impedance.

W = watts.

Cond. in Series with db. meter = .25 μfd.

Applying the 1N34 as Discriminator for FM

The germanium 1N34 crystal provides greater audio output with less residual hum than a conventional 6H6 vacuum tube

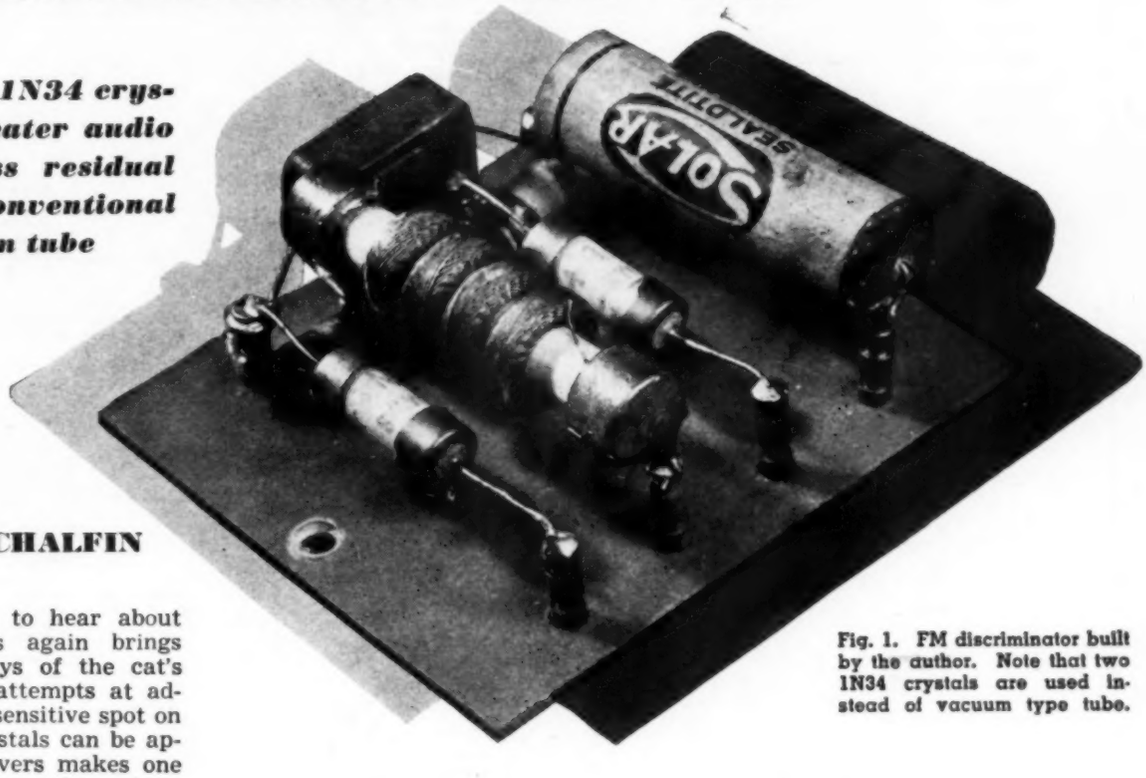


Fig. 1. FM discriminator built by the author. Note that two 1N34 crystals are used instead of vacuum type tube.

By
NORMAN L. CHALFIN

FOR most of us, to hear about crystal detectors again brings back the old days of the cat's whisker and tedious attempts at adjustment to the most sensitive spot on the crystal. That crystals can be applied in modern receivers makes one think of clothing style cycles, where the same fashions reappear periodically. The new crystals are of different materials than those the old timers knew. The 1N34 with which this paper is concerned is a germanium crystal. Other crystals of iron pyrites and of silicon have been used in wartime applications, as have uranium oxide crystals. Most applications have been the uses as detectors and mixers at the microwave frequencies. We shall concern ourselves here with their use as a second detector (discriminator) for FM receivers.

Two receivers in the author's home —one for television reception and the other for FM—were rewired to include the unit shown in Fig. 1 in order to determine how well the germanium 1N34 crystal rectifiers could be used as discriminators. The television receiver was built up originally from a kit and its sound channel was designed for AM reception, therefore, the reception of the sound channel, which is FM under present standards, had to be accomplished by "side-slope" detection. This is not a satisfactory way to receive FM signals. In order to improve this condition the sound i.f. coil, which in this receiver was a solenoid coil with primary and secondary on the same form, was made into a discriminator coil by the simple expedient of centertapping the secondary and coupling the hot side of the primary with a 50 $\mu\mu$fd. capacitor to this centertap. The sound i.f. amplifier was pressed into service as a limiter and a pair of 1N34s were wired as the discriminator. The circuit of this arrangement is shown in Fig. 3. A sketch of the detector i.f. coil tuned discriminator is shown in Fig. 5.

For comparison, a 6H6 was wired into the circuit. It was found that the 1N34 delivered more audio to the a.f. amplifier than the vacuum tube. There was no residual hum with the 1N34 while with the 6H6 there was a detectable 60 cycle ripple when observed on the oscilloscope. The hum from the 6H6 could not, however, he heard on the speaker.

Since the experiments herein described were performed, *Sylvania* has announced the 1N35. This comprises two 1N34s in a single assembly. The two units are "matched." The 1N35 can be used exactly as has been described above and as illustrated in the diagrams.

There are also available at many of the parts suppliers' shops 1N21 crystal detectors from wartime sur-

(*Continued on page* 150)

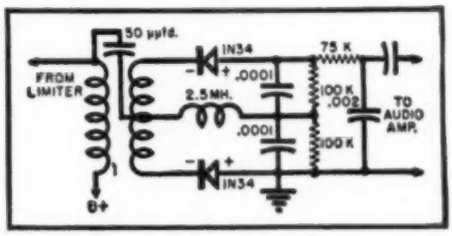
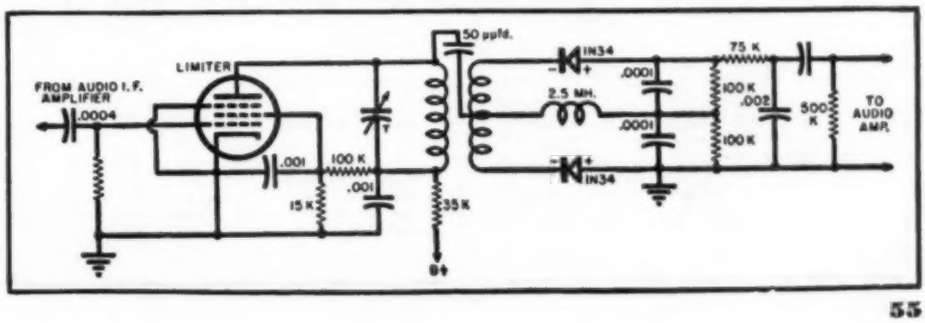


Fig. 2. Circuit diagram of a conventional Foster-Seeley discriminator using 1N34 germanium crystal detectors.

Fig. 3. Circuit diagram of FM broadcast discriminator using two 1N34 crystals. This circuit is similar to a television sound i.f. system except for bandwidth, for television ± 25 kc. deviation is used, while for FM ± 75 kc. deviation is needed.



AROUND THE CLOCK WITH SHORT-WAVE ENGLISH NEWSCASTS

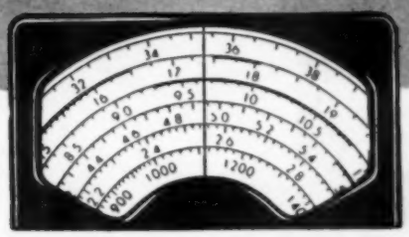
EST	LOCATION	CALL	FREQ.*
7:00 a.m.	Bandoeng, Java	PLP	11.000V
7:00 a.m.	Chungking	XGOY	6.143V
			7.152
7:00 a.m.	Montreal, Quebec	CFCX	6.005
7:00 a.m.	Toronto, Ontario	CFRX	6.070
7:00 a.m.	Halifax, Nova Scotia	CHNX	6.130
7:00 a.m.	Sydney, Nova Scotia	CJCX	6.010
7:00 a.m.	Los Angeles (AFRS)	KGEI	9.530
		KCBA/F	9.750
7:00 a.m.	Melbourne (BBC, Radio Newsreel)	VLR2	6.150
		VLH3	9.580
7:00 a.m.	Moscow (To North America)	Radio Centre	11.630
			11.720
			15.180V
			15.360
			17.820
7:15 a.m.	Helsinki (Lahti), Finland	OIX2	9.505V
		OIX4	15.190
7:15 a.m.	Los Angeles (AFRS, At Dictation Speed)	KGEI	9.530
		KCBA/F	9.750
7:15 a.m.	London (European Service, At Dictation Speed)	GRI	9.410
		GRX	9.690
		GVU	11.770
		GSE	11.860
7:30 a.m.	Georgetown, Br. Guiana (Caribbean News Bulletin)	ZFY	6.000
7:30 a.m.	Melbourne (To Forces)	VLA8	11.760
		VLC4	15.320
		VLB8	21.600
		VLG9	11.900
7:30 a.m.	Singapore	Radio Malaya	15.300
			15.275
			11.735V
			6.770
7:30 a.m.	Delhi	AIR	4.960
			7.290
			11.850
			15.290
	Bombay		7.240
	Calcutta		7.210
		(or	6.010)
	Madras		7.260
		(or	4.920)
7:30 a.m.	Colombo, Ceylon	Radio SEAC	11.770
			6.075
7:45 a.m. (irreg.)	Pnompenh, Fr. Indo-China	Radio Combade	12.364V
7:45 a.m.	Moscow (To North America, Moscow Newsreel)	Radio Centre	11.630
			11.720
			15.180V
			15.360
			17.820
7:45 a.m.	London (European Service)	GRI	9.410
		GWO	9.625
		GVU	11.770
		GVX	11.930
8:00 a.m.	Los Angeles (AFRS)	KGEI	9.530
		KCBA/F	9.750
8:00 a.m.	Moscow (To North America)	Radio Centre	7.360
			11.630
			11.720
			11.890
			15.180V
			15.440I
	Via Komsomolsk		9.565V
8:00 a.m.	Melbourne (To East U.S., Canada, South Africa)	VLB	9.540
		VLC7	11.840
8:00 a.m. (irreg.)	Melbourne (BBC, followed by A.B.C. at 8:05 a.m.)	VLR2	6.150
		VLH3	9.580
8:00 a.m.	Perth (BBC, followed by A.B.C. at 8:05 a.m.)	VLW7	9.520
8:00 a.m.	Brisbane (BBC, followed by A.B.C. at 8:05 a.m.)	VLQ2	7.215
8:00 a.m.	Colombo, Ceylon (BBC)	Radio SEAC	11.770
			6.075
8:00 a.m.	Tokyo (AFRS)	JLR	6.015
			4.880V
8:00 a.m.	London	GSN	11.820
		GRY	9.600
		GSV	17.810
		GSJ	21.530
		GSH	21.470
8:00 a.m.	London	GSK	26.100
		GRF	12.095
		GSO	15.180
		GSD	11.750
		GSI	15.260
		GVS	21.710
		GRA	17.715
		GSF	15.140
8:00 a.m.	Georgetown, Br. Guiana (BBC)	ZFY	6.000
8:00 a.m. (Mon., Wed., Fri.)	Makassar, Celebes	Radio Macassar	9.360V
8:00 a.m.	Akashvani, Mysore, India	VU7MC	6.065
8:00 a.m.	Montreal, Quebec	CFCX	6.005
8:00 a.m.	Toronto, Ontario	CFRX	6.070
8:00 a.m.	Halifax, Nova Scotia	CHNX	6.130
8:00 a.m.	Sydney, Nova Scotia	CJCX	6.010
8:30 a.m.	Leopoldville	OTC5	17.770
		OTC2 (or	9.745V)
8:30 a.m. (irreg.)	Bucharest	Radio Bucharesti	9.252
8:30 a.m.	Melbourne (To Forces)	VLA8	11.760
		VLG9	11.900
8:45 a.m.	Rangoon, Burma	Radio Rangoon	9.543
8:45 a.m.	London (European Service, At Dictation Speed)	GRI	9.410
		GWO	9.625
		GVU	11.770
		GVX	11.930
9:00 a.m.	Chungking	XGOY	6.143V
			7.152
	Via Nanking	XGOA	9.730
	Via Canton	XTPA	11.650
	Via Shanghai	XORA	11.695V
	Via Kweiyang	XPSA	7.010
	Via Hankow	XLRA	6.054
	Via Tai-Pei, Formosa	XUPA	9.695
			6.015I
9:00 a.m.	Melbourne (To East U.S., Canada, South Africa)	VLB	9.540
		VLC7	11.840
9:00 a.m.	Colombo, Ceylon	Radio Colombo	4.900
9:00 a.m.	Saigon, Fr. Indo-China	Radio Saigon	11.780
			4.810
9:00 a.m. (irreg.)	Kuala Lumpur, Malaya (Relayed from Singapore)	Radio Kuala Lumpur	6.175
9:00 a.m.	Los Angeles (AFRS)	KNBI	6.060
		KNBA	9.490
		KNBX	11.790
		KCBR	9.700
		KGEX	11.730
		KWID	9.570
	Via Honolulu	KRHO	9.650
9:00 a.m.	Toronto, Ontario	CFRX	6.070
9:00 a.m. (Sun.)	Halifax, Nova Scotia	CHNX	6.130
9:00 a.m.	Singapore (BBC)	Radio Malaya	4.776
9:20 a.m.	Singapore	Radio Malaya	15.300
			15.275
			11.735V
			6.770
9:30 a.m.	Chungking (Press Dispatches to America, At Dictation Speed)	XGOY	6.143V
			7.152
9:30 a.m.	Melbourne (To Forces)	VLA8	11.760
		VLC4	15.320
		VLG9	11.900
9:30 a.m.	Delhi	AIR	15.160
			9.670
			9.590
			7.210
			11.870
	Bombay		3.360V
	Madras		4.920
10:00 a.m.	Los Angeles (AFRS)	KNBI	6.060
		KNBA	9.490
		KNBX	11.790
		KCBR	9.700
		KGEX	11.730
		KWID	9.570
	Via Honolulu	KRHO	9.650
10:00 a.m.	Vatican	HVJ	15.095
			9.660
			5.970VI
10:00 a.m.	London (GOS, Radio Newsreel)	GRY	9.600
		GSF	15.140
		GSN	11.820
		GSJ	21.530
		GSP	15.310
		GSH	21.470
		GSV	17.810
		GSK	26.100
		GRF	12.095I
		GSO	15.180I
		GRQ	18.025
		GSD	11.750I
		GVS	21.710
		GVP	17.700
10:05 a.m.	Stockholm (To North America)	SBT	15.155
		SDB-2	10.780
10:10 a.m.	Rangoon, Burma (Headlines)	Radio Rangoon	9.543
10:15 a.m.	Melbourne (To Britain)	VLC4	15.320
		VLG9	11.900
		VLA8	11.760
		VLB9	9.615
10:15 a.m.	Bandoeng, Java	PLP	11.000V
10:30 a.m.	Delhi	AIR	6.110
			9.590
			3.495
			11.850
			9.670
			6.190
			7.210
			11.870
	Bombay		3.360V
	Madras		4.920
10:30 a.m.	New York	WCBN	15.270
		WCBX	17.830
		WCRC	21.570
	Schenectady	WGEO	15.330
	Boston	WRUL	15.290
	Cincinnati	WLWL	17.955
10:55 a.m.	Manila	KZPI	9.710
11:00 a.m.	Johannesburg, So. Africa (BBC)		6.007
			9.912I
	Capetown (BBC)		5.877V
11:00 a.m.	Colombo, Ceylon (BBC)	Radio SEAC	11.770
		Radio Colombo	6.075
11:00 a.m.	Delhi (BBC)	AIR	4.900
			6.110
			9.590
			3.495
			11.850
			9.670
			6.190
			7.210
			11.870
			7.290
	Bombay (BBC)		3.360V
	Madras (BBC)		4.920
11:00 a.m.	Georgetown, Br. Guiana (BBC)	ZFY	6.000
11:00 a.m.	Melbourne (To West U.S.)	VLG4	11.840
		VLC6	9.615
		VLA8	11.760
11:00 a.m.	Addis Ababa, Ethiopia (BBC)	Radio Addis Ababa	9.620V
11:00 a.m.	Nairobi, Kenya	VQ7LO	4.950
11:00 a.m.	Hamburg, Germany	BFN	6.060
			7.290
11:00 a.m.	Chungking	XGOY	6.143V
			7.152
11:00 a.m.	Moscow (To Britain)	Radio Centre	11.630I
11:00 a.m.	London (ES)	GRH	9.825
		GVY	11.955
11:00 a.m.	London (AS)	GVO	16.080
		GSI	15.260
11:00 a.m.	London (GOS)	GSN	11.820
		GSB	9.510
		GSP	15.310
		GSH	21.470
		GSV	17.810
		GRF	12.095
		GSO	15.180
		GSF	15.140
		GRQ	18.025
		GSD	11.750
		GVS	21.710
		GVP	17.700
11:15 a.m.	Bandoeng, Java	PLP	11.000V
11:30 a.m. (irreg. at 11:00 a.m.)	Accra, Gold Coast (BBC)	ZOY	7.300
			4.915
11:30 a.m.	Georgetown,	ZFY	6.000

(Continued on page 110)

*Frequencies shown are in megacycles: to convert to meters, divide 300 by the frequency in megacycles, or 300,000 by the frequency in kilocycles; 1000 kcs. equal 1 megacycle.

NOTES: A. B. C.—Australian Broadcasting Commission (domestic network). AFN—Armed Forces Network. AFRS—Armed Forces Radio Service. AIR—All India Radio. AS—African Service. BBC—Relay from London. BFN—British Forces Network. ES—Eastern Service. FES—Far-Eastern Service. GOS—General Overseas Service. I—Frequency used irregularly. NAS—North American Service. PS—Pacific Service. RNE—Radio Nacional de Espana. RNF—Radio Nationale Francais. SABC—South African Broadcasting Corporation. SEAC—Southeast Asia Command. V—May vary in frequency from that noted.

International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

THIS month we are taking our ISW readers on a brief survey of radio in a picturesque, little country of Europe—Holland—the land of tulips, dykes, and windmills. We dedicate this issue of ISW to the pioneer short-wave broadcaster on the Continent—a voice long heard around the world—PCJ, *"The Happy Station of a Friendly Nation."* To the capable staff of *"The Happy Station"* we extend heartiest congratulations on this *twentieth* anniversary of PCJ, and to *Radio Nederland* goes our sincere best wishes for the future of this *"International World Program Station."*

The Story of PCJ

The history of PCJ actually dates back to 1926, when the first short-wave transmitter was constructed in the Philips Laboratories in Eindhoven, where many expensive experiments were conducted. Of these experiments, Eddie Startz, versatile announcer at the station, relates:

"The object was not record-breaking—in such case a less carefully designed transmitter would have been sufficient—but to find out whether a really reliable wireless transmission over very long distance was possible."

In order that readers may have a few details of the Philips experiments, we quote from a 1929 pamphlet about PCJ, as prepared by Mr. Startz:

"Since we proved that the radio-waves, under 100 meters, possess special advantageous features for radio transmission and make it possible to bridge the biggest distances with small power, radio has been revolutionized. The extraordinary feature of the short waves were soon utilized for telegraph communications; but short-wave radio telephony proved, until recent years, practically impossible.

"To telegraph from Holland to the Indies on the long waves (over a thousand meters) it proved necessary to use a power of some 300 kw. The long wave telephony transmitter of the Transatlantic Service (approx. 500 km.) also used a power of some hundreds of kilowatts.

"For wireless telephonic communications with the Dutch East Indies, on a very long wave, it would be impossible to construct a transmitter of sufficient power to bridge the 20,000 km.

"But the results obtained with short-wave telegraphy made one wonder if it were not possible to establish a telephony service over the same distance with short waves. Only experiments could prove if this were possible, and if so, to what extent.

"The Philips Laboratories at Eindhoven, with their innumerable resources, were certainly the best equipped to conduct such expensive experiments.

"Not only was thought given to a possible two-way connection in the near future with the Indies (which has come into existence in the meantime) but also of a possible world-wide broadcast service. The wavelength (31.28 meters, or a frequency of 9590 kcs.) was chosen with a view to obtaining good universal reception.

"Telephony transmissions on ultra short wavelengths are often unsuccessful, because of the inconsistency of the transmitted wavelength. With the usual modulating and receiving systems the speech currents delivered by the microphone are intended solely to vary the amplitude and not the frequency of the oscillations generated by the transmitter. Unfortunately, if no special precautions are taken, there will be 'frequency-modulation,' as it is called by the engineers, and this would cause a very bad distortion.

"In the Philips transmitter, call-sign PCJ, this difficulty has been overcome by the use of an oscillating quartz-crystal, which keeps the transmitting frequency constant between very close limits.

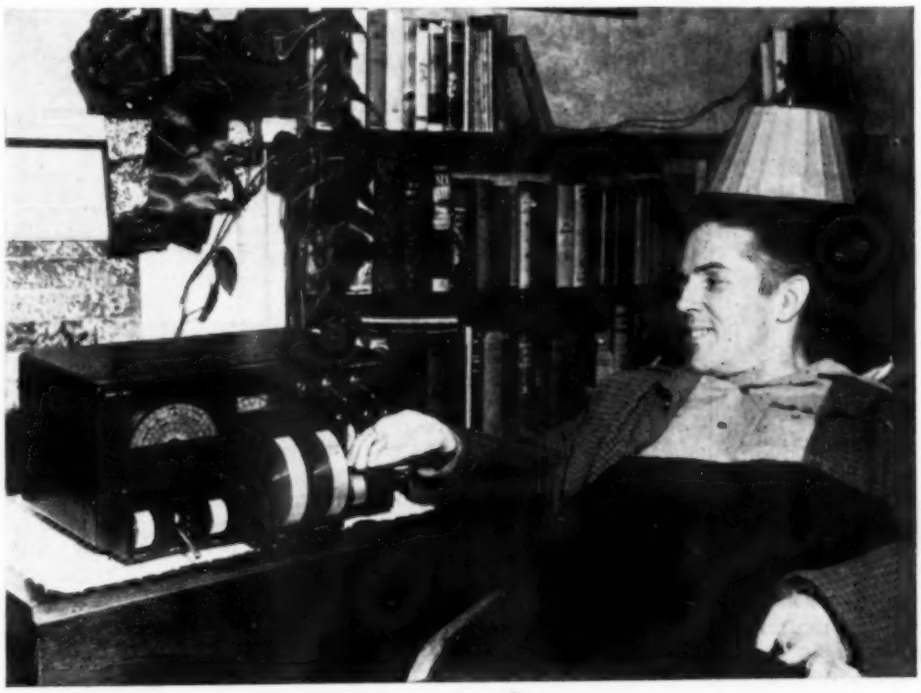
"Some crystals show the so-called piezoelectric effect, discovered by Madame Curie. If such a crystal is compressed, an electromotive force is generated on its surfaces; the reverse is true, too—if an e.m.f. is applied, the crystal contracts.

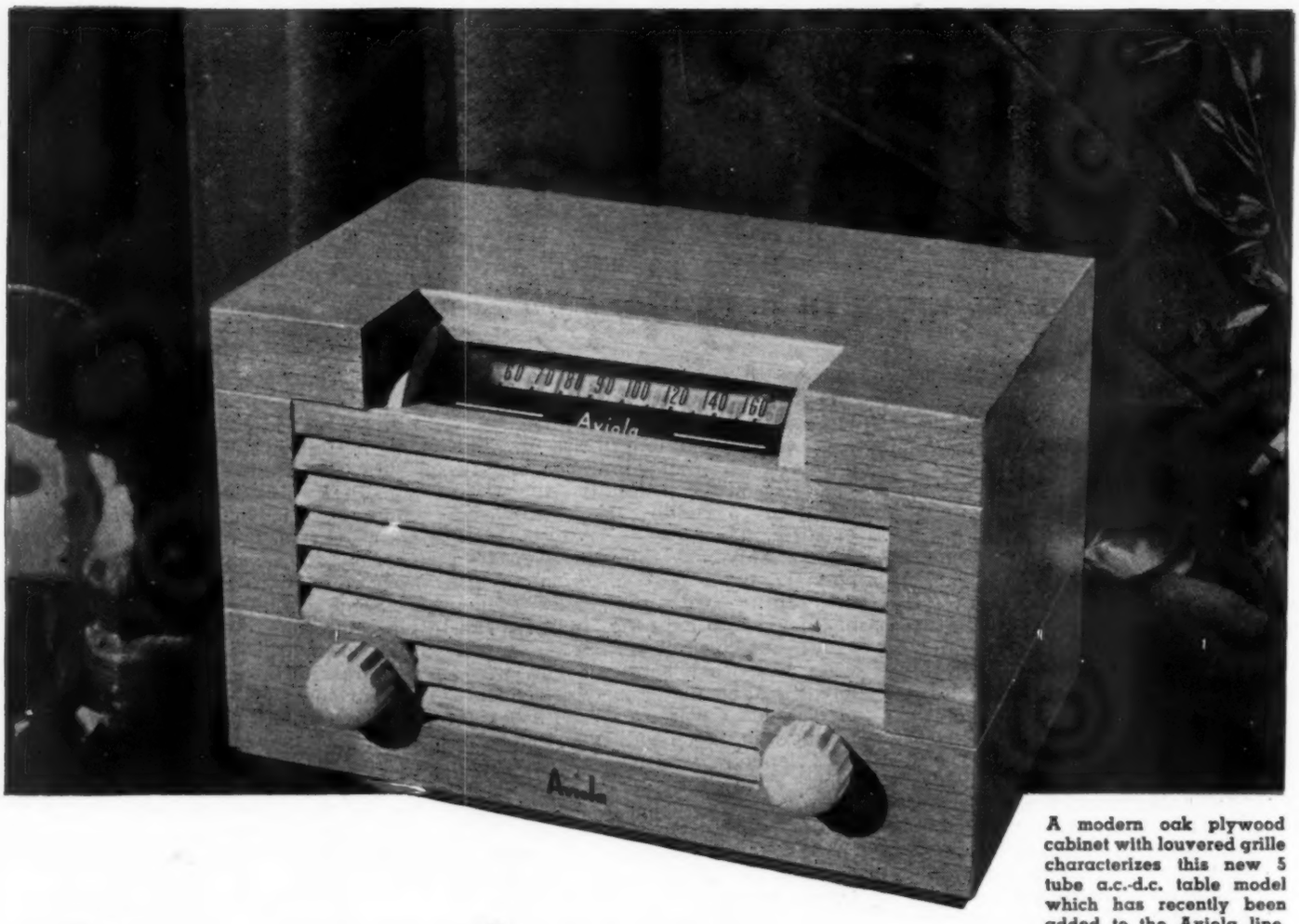
"In a crystal oscillator this property of a thin plate of quartz crystal, capable of oscillating mechanically at a very high frequency, is utilized to generate a current of very constant frequency.

"In the PCJ transmitter the crystal generated high frequency currents are amplified and multiplied several times

(*Continued on page* 94)

One of the newest devotees among short-wave listeners is David Van Wallace of Mount Clemens, Michigan. David, a former Notre Dame student, is completely paralyzed as the result of a broken neck suffered from a dive into the University pool. Unable to operate a conventional receiver, two former Notre Dame alumni, Raymond Durst and William Maher of Hallicrafters called upon the company engineers to design a special radio chassis with huge wheels and long levers replacing knobs and switches. The slightest brushing movement of Mr. Van Wallace's hand will manipulate the controls. Receiver was donated by The Hallicrafters Company.





A modern oak plywood cabinet with louvered grille characterizes this new 5 tube a.c.-d.c. table model which has recently been added to the Aviola line.

Practical RADIO COURSE

By
ALFRED A. GHIRARDI

Part 52. The i.f. amplifier in superheterodyne receivers; what it accomplishes, and operating characteristics that influence its design.

BEFORE proceeding to study the intermediate frequency (i.f.) amplifier it will be instructive to briefly review the basic operating principle of the superheterodyne receiver so that the important roles played by the i.f. amplifier will be clearly understood. The functional block diagram of a typical AM superheterodyne is illustrated in Fig. 1.

We have learned that the modern superheterodyne usually employs a tuned r.f. preselector stage into which all the signals received by the antenna are fed. The main function of its variable-tuned circuits is the rejection of certain interfering signals that may be present along with the desired signal—particularly those of *image* frequency, since neither the mixer nor the i.f. amplifier following it are capable of discriminating between such signals and the desired signal. Consequently, rejection of all interfering signals of image frequency must be accomplished *ahead* of the mixer. Preselector circuits that when tuned to the desired signal will reject all possible interfering image-frequency signals are employed for this purpose. The variable-tuned signal circuits in the preselector shown in Fig. 1 are assumed to be adjusted to pass mainly the *desired* signal, *B*, of the three incoming signals *A, B, C* appearing simultaneously in the antenna circuit.

Following the preselector is the "frequency-converting" or "translating" arrangement wherein any received signal (unmodulated c.w., audio modulated, or video modulated) transmitted by the preselector is "converted" or translated to a *similarly modulated* signal of new fixed carrier frequency. To perform this change in frequency (*frequency conversion*), an arrangement comprising an adjustable-frequency r.f. oscillator and a mixer is employed. Both units considered together comprise the *frequency converter*. The modulated input r.f. signal voltages and the unmodulated r.f. voltage (of suitable frequency) generated by the oscillator are both properly applied to the *mixer* portion of the frequency converter (see Fig. 1), so as to cause them to heterodyne within the mixer to produce a plate current having several "combination" frequencies. Among these are components of "sum" ($f_{osc.} + f_{sig.}$) and "difference" ($f_{osc.} - f_{sig.}$) frequencies —both of which are really carriers of new frequencies but which still carry the modulations of the input carrier.

Of these, the desired component *of the desired signal* (usually the component of *difference* frequency) is selected by the fixed-tuned plate load circuit and passed on to the highly efficient and selective fixed-frequency *intermediate amplifier* whose function it is to further attenuate all the other (undesired) output components and signals appearing in the output circuit of the frequency converter, and to greatly amplify the desired component of the desired signal (usually called the *i.f. signal*) to the required level

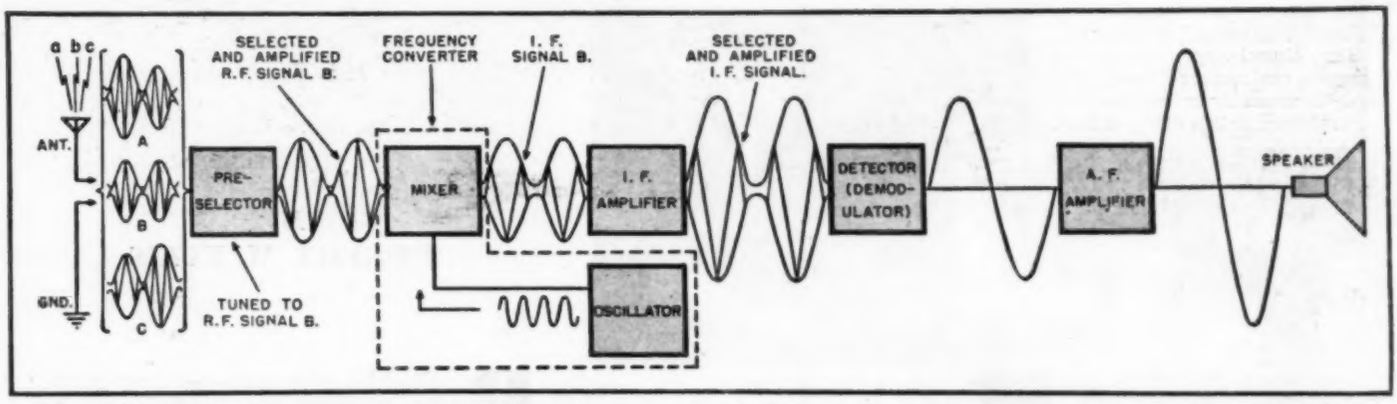


Fig. 1. Functional block diagram of a typical AM superheterodyne receiver showing the successive changes that the desired modulated incoming signal B undergoes as it progresses successively through the preselector, frequency converter, and i.f. amplifier of the receiver.

before it is applied to the detector or demodulator tube.

The I.F. Amplifier

From the foregoing it is clear that the intermediate-frequency amplifier can be defined as that portion of a superheterodyne receiver that lies (electrically) between the plate circuit of the frequency converter and the input of the detector or demodulator. It is essentially a highly efficient and selective fixed-tuned high-frequency amplifier which derives its input signal from the plate circuit of the frequency converter, since this is the point at which the i.f. currents first appear. Since the i.f. amplifier provides the principal gain and adjacent-channel selectivity of the superheterodyne receiver, its operation and design merit careful attention and they will be treated at some length in this and succeeding lessons of this series.

Advantages of Superheterodyne over T.R.F. Receiver System

The advantages of the superheterodyne receiver system over the straight t.r.f. receiver employing an equal number of high-frequency amplifier stages and tuning circuits are:

1. In a properly adjusted and aligned superhet receiver, it makes no difference what the carrier frequency of the desired signal being received is; the frequency converter always converts it to the single frequency for which the i.f. amplifier of the receiver is designed—the i.f.—and most of the amplification and selection is accomplished at this one frequency. Since the signals the i.f. amplifier is called upon to amplify are always of this one carrier frequency, *fixed-tuned* circuits (tuned to this predetermined i.f.) can be employed in it. This results in more nearly constant over-all receiver sensitivity and selectivity over the waveband since their efficiency does not depend on the particular frequency of the received signal as is the case in a t.r.f. receiver.

2. Higher possible gain per stage may be realized in the i.f. amplifier than in a t.r.f. amplifier, especially when the i.f. is a *lower* frequency than the signal frequency.[1]

3. Improved selectivity also results, especially when the i.f. is a *lower* frequency than the signal frequency, since a narrower response curve (higher selectivity) may be obtained than is possible at the signal frequency.[1]

4. Better control of over-all fidelity (as regards sideband cutting) is obtainable because it is more easily possible to control the shape of the over-all resonance curve of the fixed i.f. tuning circuits to a definite desired characteristic for all incoming signals. It is possible, by means of simple tuning adjustments, to shape this over-all

(*Continued on page* 147)

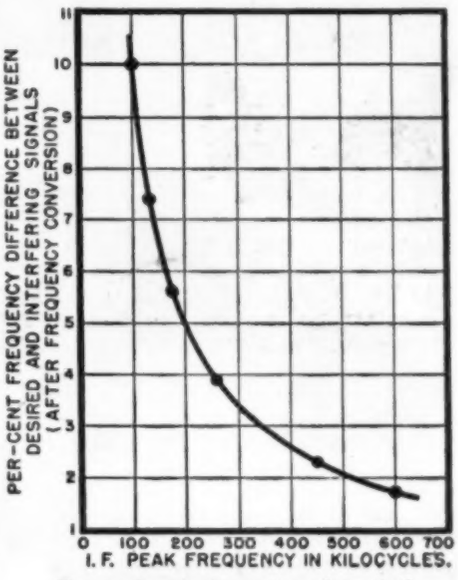
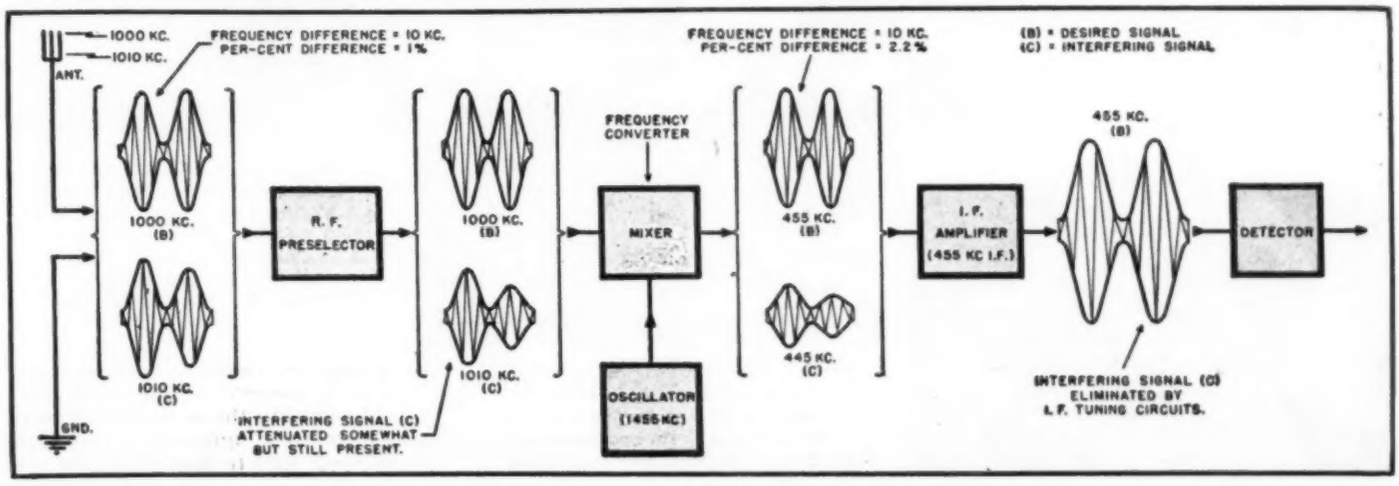


Fig. 3. Graph shows the effect of i.f. values employed in receiver upon the per-cent frequency difference between wanted and adjacent-channel interfering signals (after frequency conversion). The greater this frequency difference the greater will be the selectivity advantage of the i.f. amplifier.

[1] Even when the i.f. is a *higher* frequency than the signal frequency, improved gain and selectivity may be obtained owing to the greater possible efficiency that may be realized in fixed-tuned circuits of proper design as compared with a variable-tuned system.

Fig. 2. Block diagram illustrates the effect of superheterodyne frequency conversion of two interfering signals upon the per-cent difference between their carrier frequencies, and upon the selectivity problem involved in their separation.



By
ROBERT M. ELLIS

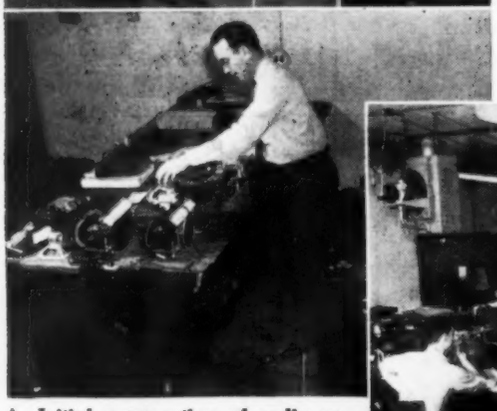
PROBABLY the weakest link in the radio industry for many years has been the absence of a pipe-line between the set manufacturer and the radio serviceman. Millions of dollars have been spent on promotion, advertising, and good will gestures, but only a few manufacturers have undertaken to supply the serviceman with data on his receivers that would offer more than mediocre help. Instead, too much time was spent analyzing the competitive market and the race was run to see who could produce a six-tube job for thirty-five cents less than the guy across the street.

At the end of the war Mr. and Mrs. Public were eager to buy the maze of new sets that had been promised to them. They had been told that the new models would be far better than those they had previously used in their homes. Unfortunately, in many cases, these were but idle rumors and thousands of receivers appeared in the radio servicemen's shops for major repairs after having been in service for but a few hours. Servicemen reported that they had found poor substitutes, "rats' nests" type of construction, innovations in circuit design, and trick tuning assemblies. A further contribution to the sale of aspirin were the many omissions and errors in original parts lists which accompanied the postwar receivers. In fact

↓ Start of disassembly operation. Here, chassis, speakers, record changers are removed from cabinets. Disassembly instructions are prepared from actual study of unit.

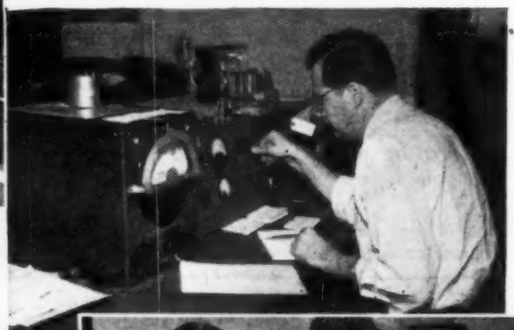
↑ Howard W. Sams, originator of PhotoFacts service.

↓ One section of Engineering Analysis Division. Here, each piece of equipment is subjected to an analysis, including replacement parts check, study of parts values and other important items.

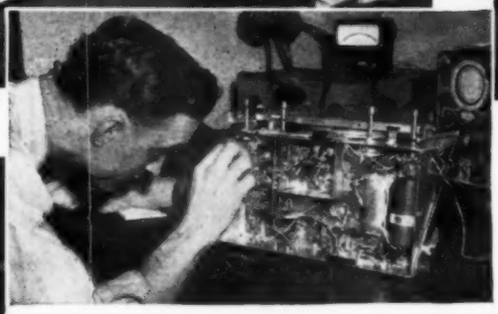


↑ Initial preparation of radio receiver chassis includes general inspection of all components and all accessories used with the unit.

↓ Specially constructed copper test booths are used when analyzing and otherwise checking the r.f. and i.f. coils. Findings are cross checked against those given by manuafcturer.



↑ Here, original speaker equipment is studied for the purpose of recommending accurate replacement. This is typical of the parts replacement analysis. Replacement recommendations are made only after checking against the actual physical and electrical characteristics of the original component.



↑ Here, a schematic diagram is being corrected to conform with the actual circuit as it exists in the processed receiver. This particular service precludes errors which may have occurred between the drafting rooms and production lines at the factory.

←This job requires the services of expert personnel. These engineers are shown measuring the stage gain and overall performance of various receivers under analysis.

↑ A tough assignment and one requiring a great amount of patience is the tracing of unknown circuits and the preparation of schematic drawings. The average serviceman could be stumped on this job.

PACKAGED RADIO SERVICE

It takes many specially trained experts and considerable equipment to prepare complete and accurate service data on complicated radio and television sets. Here is how it is done by one alert organization.

many of these sets came through without a schematic.

To solve this dilemma and to make the radio serviceman the really important figure he should be in the industry, *Howard W. Sams & Co., Inc.*, was founded on April 1, 1946. Their objective was to furnish complete pictorial, schematic, and photographic data on all postwar sets and to supply these to the radio repairman in the form of *"PhotoFact Folders."*

To tackle such a tremendous project required highly detailed planning and coordination. It was necessary to build up a staff of experts, each specializing in certain parts of the sets depending upon his particular qualifications and background. From a small beginning, the staff now includes approximately forty-five employees.

The "machinery" needed to compile and publish a single *"Folder"* presents an interesting study in organization and technique. The process of analyzing the set, called the "disassembly process" by the staff, is conducted by a group of qualified men, each specially trained for his job.

Each major group of components is classified—the responsibility being assumed by one man. For example; the capacitor specialist examines all the fixed capacitors in each piece of equipment assigned to him. He lists them all in the order of their use and prepares a separate specification sheet for each capacitor. One of each of these sheets is forwarded to each of the cooperating component parts manufacturers, together with recommendations for proper replacements. Later he checks these for electrical and mechanical specifications and, if practical and workable, he then lists the item as a correct replacement for the capacitor used in the original set.

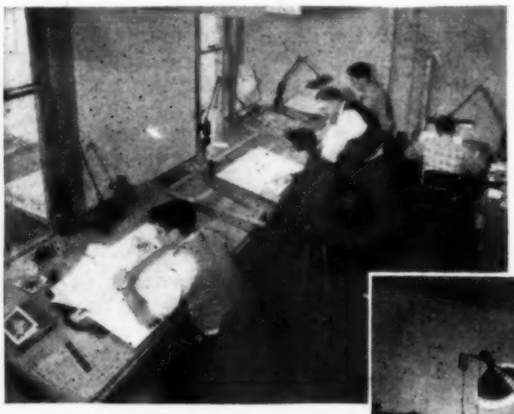
The same technique is used in analyzing replacements for fixed resistors, volume controls and tone controls. Speakers are measured both electrically and mechanically and the cooperating speaker manufacturers are asked to recommend suitable replacements on the basis of these specifications submitted to them by the speaker specialist. When the replacement speaker is received, it is checked against the original speaker in the set. Power transformers, audio transformers, and chokes are the responsibility of still another analyst. Proper replacements for these are selected by the same process as mentioned.

Of great importance is the measurement and analysis of r.f. and i.f. coils found in the maze of receivers coming into the organization for test. Great care is exercised to see that no errors creep in.

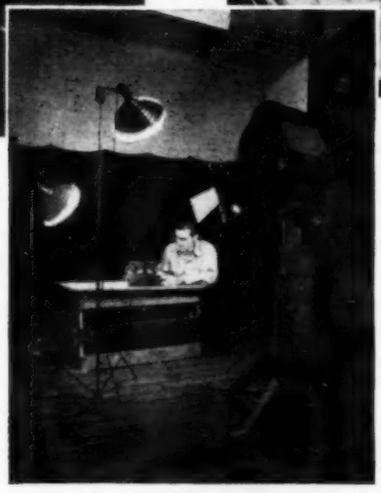
As far as the processing of the receiver itself is concerned, a complete voltage and resistance analysis of the set is made and recorded. Important details, usually overlooked by manufacturers, such as dial-cord stringing, are sketched and marked for future reference and are later incorporated in the finished *"Folder."* This one operation alone has saved countless dollars in valuable time to thousands of servicemen. It is a well known fact that only one out of four possible stringing contortions is correct.

The final step in the analysis consists of an over-all performance check including a study of stage gain and alignment. The manufacturer's schematic diagrams and parts lists (if available) accompany each receiver as it goes through the hands of the various analysts. As a matter of fact, only about 7 out of every 10 receivers are furnished with a parts list. This means, at best, that the servicemen

(*Continued on page* 144)



↑ View of drafting department. Diagrams, retouching and final art work for folders are prepared here under the guidance of Analysis Division experts.



Photographing the chassis. A special technique is used so that all parts are readily identifiable in the pictorial diagrams. →

↑ Draftsman coding pictorial diagrams and schematics with identifying parts numbers to provide uniform, easy reference to accompanying service data.

↓ A specialist checks parts functions of a record changer. From the data compiled, "exploded-view" pictorials and repair and adjustment data will be prepared.

Have you ever spent a few hours trying to restring the dial cord on a set? The drawing being prepared shows the one and only correct way to do it. →

The Farm Market for RADIO and APPLIANCES

By C. R. ELDER
Extension Editor, Iowa State College of Agriculture

Don't overlook the ever-growing farm market as a profitable source of increased income for you.

EVERY time a rural farm home is connected to an electric highline, radio and appliance stores can ring up approximately $700 in their cash registers—in terms of potential business.

That's what a recent survey of some 10,000 Iowa farm users of electricity indicate they spend for electrical equipment and appliances.

This survey, conducted by the Iowa Rural Electric Cooperative Association, in cooperation with the Iowa State College, further indicates that farmers now enjoying electricity intend to buy $260 worth of appliances in addition to those they are now using.

Put these two sources of potential business together and it would appear that the rural market is destined to become the most fertile field in the radio and appliance business.

Electricity on farms is still in its infancy. In Iowa, for example, less than one farm in seven had highline service 10 years ago. Today more than half of the farms have been electrified. Of the 107,000 farms which had power line service in 1940, 56% were serviced by cooperatives under the Rural Electrification Administration. Of the farms now being electrified, 5 are being added to REA lines and one to lines of private utility companies.

During the war years farm income was about twice the average income for the 10-year period from 1934 to 1943. Even if prices decline somewhat, farmers should be in a relatively strong position to maintain high purchasing power during the next few years. Much of the accumulated capital of farm families has been definitely earmarked for farm and home improvements. Many of these improvements, such as installation of running water, modern kitchens, farm ventilation and heating systems, require electric service for their most successful operation. This means that the demand for rural electrification should increase along with the average consumption per farm.

It is anybody's guess as to what extent electricity will eventually be used on farms. The kwh. consumption has been on the constant increase and there is no indication that the peak has been reached.

During the first year that cooperatives operated in Iowa the average consumption was 52 kwh. per month. In the seventh year of operation this average had jumped to 109 kwh.

It must be remembered, too, that many of the farms included in the seventh year of operation (1943) had been connected to the highline for a relatively short time—and at a period when equipment and appliances were practically nonexistent because of war time shortages.

(*Continued on page* 116)

Tabulation of electrical equipment now being used, or to be purchased, as indicated by a survey made among 10,000 users of electricity on Iowa farms.

Home Equipment	Percentage Using Equipment	Percentage That Intend to Buy	Farm Equipment	Percentage Using Equipment	Percentage That Intend to Buy
Radio	95.9	13.9	Separator	52.5	13.3
Washing Machine	94.4	11.0	Barn Lights	60.6	4.5
Iron	87.6	11.1	Poultry House Lights	49.9	12.9
Refrigerator	67.6	29.5	Chick Brooder	39.1	15.8
Toaster	58.3	11.9	Farm Water Pump	29.4	13.3
Vacuum Cleaner	42.4	23.6	Hog House Lights	28.8	11.2
Fans	31.7	14.4	Poultry Water Heater	15.0	13.1
Home Water Pump	26.4	17.7	Milking Machine	12.2	8.2
Clock	26.2	12.3	Electric Fence	14.0	5.7
Waffle Iron	21.4	11.5	Elevator	4.8	8.1
Heating Pad	14.0	8.5	Pig Brooder	6.0	4.6
Range	10.3	16.5	Stock Tank	2.4	7.6
Water Heater	5.5	14.1	Feed Grinder	3.3	6.1
Sewing Machine	6.5	11.1	Fanning Mill	6.2	1.5
Coffee Maker	10.2	7.3	Corn Sheller	3.4	3.3
Freezer Storage Case	.5	6.7	Dairy Water Heater	.9	1.4

3" OSCILLOSCOPE

By
J. CARLISLE HOADLEY

Panel view of home-built oscilloscope.

Complete details for the home construction of a cathode-ray oscilloscope, along with important practical information on the use of this unit.

THE most useful and versatile instrument to be found anywhere for use in a service shop, research lab., or on an experimentor's bench is the cathode-ray oscilloscope. Here in one instrument we have a peak reading voltmeter which does not load a circuit appreciably, an accurate method of comparing or determining frequency, the only method of properly and rapidly aligning wide band AM, FM and television receivers, a method of measuring modulation percentage, and the only means of observing the actual gyrations of alternating current waveforms and the study of transient waveforms. For a large part of electronic work it is indispensable and in the service shop its use is going to become more important and more necessary as FM and television receivers begin to come to the shop for repair.

The best way to fully understand the oscilloscope and realize its capabilities is to build and use one. We, therefore, present a 3" oscilloscope which will be adequate for most jobs. The design is flexible enough to allow additions to qualify it for special uses.

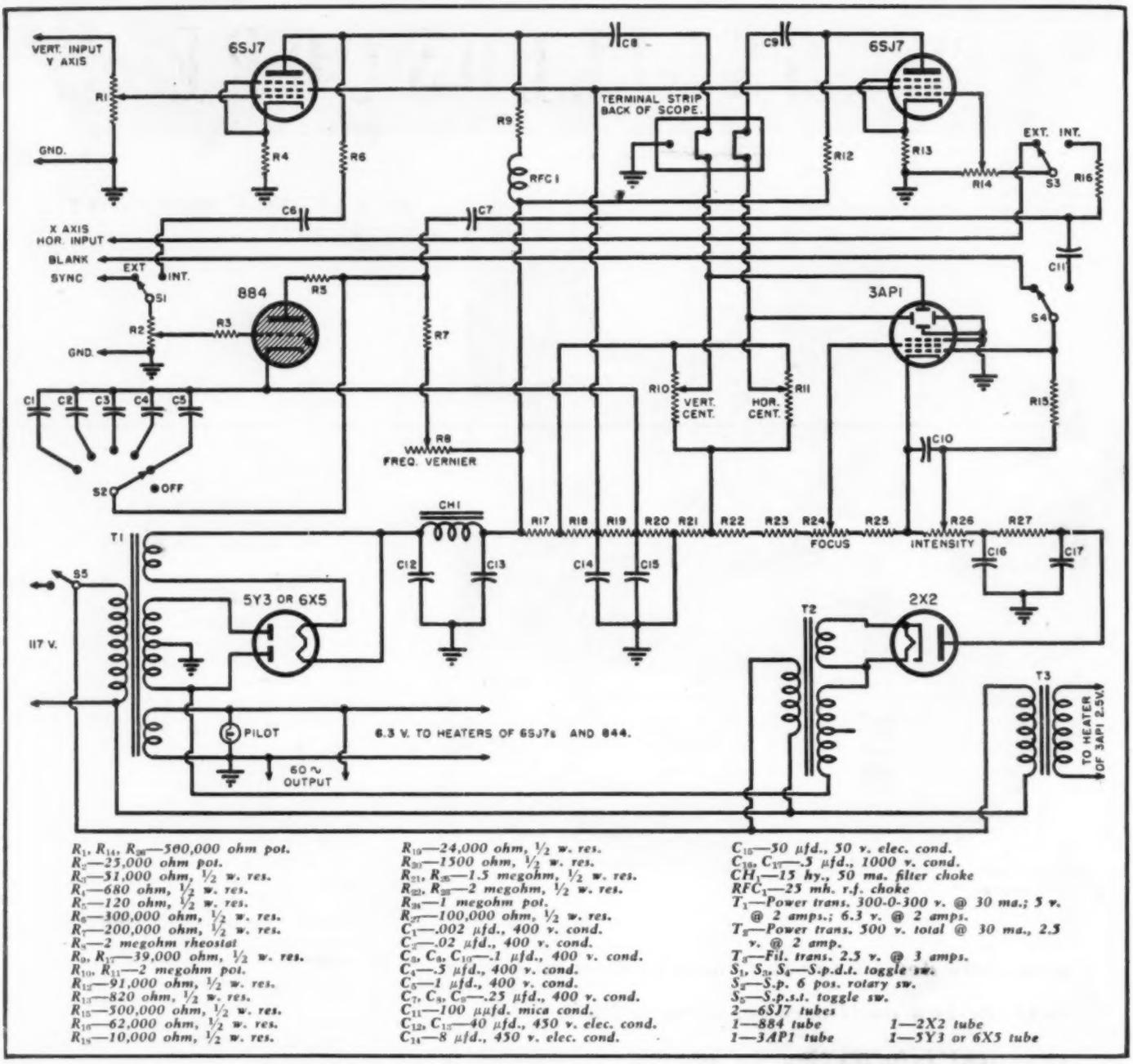
An oscilloscope consists, primarily, of a cathode-ray tube, a sweep circuit, amplifiers, two power supplies and necessary associated controls.

The cathode-ray tube consists of a cathode located at the base end of a long vacuum tube. There are, then, a succession of grids and anodes, four deflecting plates and a fluorescent screen, located at the other end of the tube. Fig. 2 shows the relative arrangement. The electron beam is focused and directed at the center of the fluorescent screen by means of the proper potentials being placed on the tube's elements. The first, or intensity, grid has applied to it a voltage negative in respect to the cathode which may be varied by a potentiometer. This pot is on the front panel and is the intensity control. It effects a change in intensity by varying the amount of electrons flowing from the cathode which are allowed to hit the screen. A positive potential which is also controlled from the front panel is placed on the focusing electrode. The deflecting plates effect electrostatic deflection of the electron beam by the application of external voltages.

As the electron beam may be taken as negative, if a positive potential is put on a deflection plate, the beam will be attracted toward that plate, provided the other plate is grounded. Conversely, if a negative potential is placed on the same plate, the beam will be repelled. As the plates are arranged in pairs at right angles to each other, the beam may be deflected either horizontally or vertically, according to the choice of plates; or, if voltages are applied to the vertical and horizontal plates simultaneously, the deflection will be in both directions at once. Therefore, the spot may be moved, by manipulation of the voltages on the plates, to any point on the face of the tube. If these voltages are d.c. and applied to the tube directly, then the spot will assume a new position, as determined by the magnitude of the voltage.

We have, therefore, what is in effect an electrostatic voltmeter. All that need be done is to put a known voltage on, say, the vertical deflection plates, and observe how many volts it requires to deflect the spot one inch. When we place an unknown voltage on the tube we merely measure the deflection of the spot. Knowing the sensitivity of the tube in volts-per-inch, we accurately determine the unknown voltage. This is a very sensitive method as it draws an almost immeasurable current from the source. One can measure even the voltage across a small charged condenser.

If we place an a.c. voltage of known frequency on one set of plates and an unknown frequency to the other set, we can determine not only the peak-to-peak value of either a.c. voltage, but we can also find the frequency difference between the two a.c. voltages if it is not too great, i.e., 10-1 or less. We will note a pattern on the screen, the shape of which is dependent upon the frequency relation be-



R_1, R_{14}, R_{26}—500,000 ohm pot.
R_2—25,000 ohm pot.
R_3—51,000 ohm, ½ w. res.
R_4—680 ohm, ½ w. res.
R_5—120 ohm, ½ w. res.
R_6—300,000 ohm, ½ w. res.
R_7—200,000 ohm, ½ w. res.
R_8—2 megohm rheostat
R_9, R_{17}—39,000 ohm, ½ w. res.
R_{10}, R_{11}—2 megohm pot.
R_{12}—91,000 ohm, ½ w. res.
R_{13}—820 ohm, ½ w. res.
R_{15}—500,000 ohm, ½ w. res.
R_{16}—62,000 ohm, ½ w. res.
R_{18}—10,000 ohm, ½ w. res.
R_{19}—24,000 ohm, ½ w. res.
R_{20}—1500 ohm, ½ w. res.
R_{21}, R_{25}—1.5 megohm, ½ w. res.
R_{22}, R_{23}—2 megohm, ½ w. res.
R_{24}—1 megohm pot.
R_{27}—100,000 ohm, ½ w. res.
C_1—.002 μfd., 400 v. cond.
C_2—.02 μfd., 400 v. cond.
C_3, C_6, C_{10}—.1 μfd., 400 v. cond.
C_4—.5 μfd., 400 v. cond.
C_5—1 μfd., 400 v. cond.
C_7, C_8, C_9—.25 μfd., 400 v. cond.
C_{11}—100 μμfd. mica cond.
C_{12}, C_{13}—40 μfd., 450 v. elec. cond.
C_{14}—8 μfd., 450 v. elec. cond.
C_{15}—50 μfd., 50 v. elec. cond.
C_{16}, C_{17}—.5 μfd., 1000 v. cond.
CH_1—15 hy., 50 ma. filter choke
RFC_1—25 mh. r.f. choke
T_1—Power trans. 300-0-300 v. @ 30 ma.; 5 v. @ 2 amps.; 6.3 v. @ 2 amps.
T_2—Power trans. 500 v. total @ 30 ma., 2.5 v. @ 2 amp.
T_3—Fil. trans. 2.5 v. @ 3 amps.
S_1, S_2, S_4—S.p.d.t. toggle sw.
S_3—S.p. 6 pos. rotary sw.
S_5—S.p.s.t. toggle sw.
2—6SJ7 tubes
1—884 tube
1—3AP1 tube
1—2X2 tube
1—5Y3 or 6X5 tube

Fig. 1. Schematic diagram of 3" oscilloscope. The frequency range of the sweep oscillator is 6 c.p.s. to 30 kc. Should a 6X5 rectifier be substituted for the 5Y3, it will not be necessary for the power transformer to have a 5 v. winding.

tween the a.c. voltages. If they are the same, we will get an ellipse; if one is twice the other, we get a figure 8. Note that this figure has two loops. As the frequency difference increases the number of loops denotes the factor by which one frequency is greater than the other. This is very useful in calibrating test equipment and works as well at radio frequencies as it does at audio frequencies.

If we wish to examine an alternating current voltage, either sinusoidal or otherwise, it is necessary to place on one set of deflection plates, usually the horizontal ones, an alternating voltage, linear in time and variable in frequency to constitute a time base or sweep. This merely starts the fluorescent spot from the left hand side of the tube and moves it to the right hand side at a constant speed. How many times per second it is moved is variable by means of a panel control. If we apply an alternating voltage to the other set of deflection plates (the vertical ones), the spot will trace out an a.c. wave in its true proportions in respect to time. The horizontal plates are usually referred to as the *X axis* plates and the vertical plates as the *Y axis*. The picture drawn with the above described sweep will appear in the same relation as the assumed *X* and *Y* axis on a mathematical graph.

An important part of an oscilloscope is the sweep circuit. This is the little electronic hand which writes the waveform shapes on the face of the cathode-ray tube. The circuit is shown in Fig. 3.

The heart of the circuit is the tube, in this case an 884. This tube is a gas filled triode. The addition of this gas has the result of changing the characteristics of the triode. For instance, with 5 volts bias on its grid it is cut off and no current flows. As the plate potential is applied, condenser *C* charges up. As it has to charge through resistor *R*, it takes a certain time to reach any given voltage. When it does charge to a certain critical voltage, the gas in the 884 tube ionizes and the tube conducts. Unlike a high vacuum tube, increasing the grid voltage will have no effect on the tube after it has once started conducting. The only way to turn it off is to remove the plate voltage.

Fortunately, this is exactly what happens. The instant the tube conducts, its resistance becomes very low and it rapidly discharges condenser *C*. When the voltage on condenser *C* falls below the critical value, the tube stops conducting. Condenser *C* then starts to charge again to repeat the

cycle. Changing the value of *R* changes the speed at which *C* can be charged. The resultant waveform is shown in Fig. 4. Therefore, the frequency of the resultant saw-tooth waveform can be changed.

The value of *C* also has an effect on the frequency. The higher the capacity, the longer it takes to charge it through a given resistor. Therefore, by switching capacitors and providing a variable resistance in series, a wide frequency range may be covered. In the oscilloscope described, the frequency range is 6 c.p.s. to 30,000 c.p.s.

This oscillator is, however, rather unstable, which is undesirable as this would cause the inspected waveform to dance back and forth; but this very instability is put to work. A bit of the signal is injected into the grid of the sweep oscillator tube. The tube will lock in with the fundamental or a multiple of the inspected waveform frequency. This causes the picture to stand still on the face of the tube. The amount of synchronizing voltage is varied by a potentiometer in the grid of the sweep oscillator tube. It is well to note here that too much sync should never be used, as it will distort the waveform under observation.

We could use the entire voltage rise of the condenser as it charges up but for the fact that it is not linear, but tends to charge rapidly at first and then more slowly, actually in the form of an exponential curve. This would not give a time base which was linear with time and would, consequently, distort the waveform under observation. We, therefore, use only the initial fast charging part which is reasonably linear and we amplify this small saw-tooth to the proper size to more than sweep the width of our 3" tube.

This amplifier tube has in its grid a volume control so that we can vary the amplitude of this sweep voltage and spread out or crowd together groups of waveforms to gain different perspectives on the observation thereof. This control is necessary when we wish to use an external sweep voltage. The amplifier must have a flat frequency response from six to, at least, thirty thousand cycles-per-second so that it will amplify the sweep without distortion. Actually, its response should be several times wider, as the frequency components involved at the discharge time may be as high as 500 kc. or more.

As we increase the frequency of our sweep oscillator, the rise of the saw-tooth becomes shorter and shorter but the fall remains relatively constant. There comes a time, therefore, when they are nearly equal. The forward trace on the tube, then, is no brighter than the back trace. The back trace becomes annoying, as it confuses the waveform that we are inspecting—it may be removed by a blanking voltage.

Simply stated, this voltage reduces the intensity of the cathode-ray tube to zero during the back cycle. A portion of the sweep voltage is fed into the intensity grid of the C-R tube through a small condenser. The positive rise of the sweep only makes the intensity grid more positive and increases the brilliance slightly at the beginning of the sweep. The fall of the saw-tooth, however, is negative and this negative voltage drives the intensity grid negative, shutting off the electron beam and blanking the tube during the flyback time. The coupling condenser must be large enough to couple the flyback voltage but small enough not to pass the saw-tooth rise frequency.

This blanking voltage may be removed at will by means of a switch. The intensity grid is brought out to a binding post so that external blanking or a calibrating voltage may be injected.

If a sine wave of a known frequency is introduced, the tube will be blanked on every other half cycle. This will be apparent by the sweep taking the form of a series of dashes as in Fig. 6. Knowing the frequency of the sine wave, we can determine the frequency of a waveform which we have placed on the vertical deflecting plates. This input to the scope constitutes the *Z axis* input. If the builder desires, a *Z* axis amplifier may be included, together with an amplitude control. This amplifier may be the same as the *Y* axis amplifier (Fig. 1) and the values copied. Fig. 7 shows how this would be arranged.

All the waveforms we wish to investigate must be of sufficient amplitude to deflect the electron beam an inch or so. The deflecting plates have a sensitivity of from 40 to 50 volts per inch of deflection, so an amplitude of less than 10 volts is not easy to study, due to its small size.

We must, therefore, provide a *Y* axis amplifier, the response of which

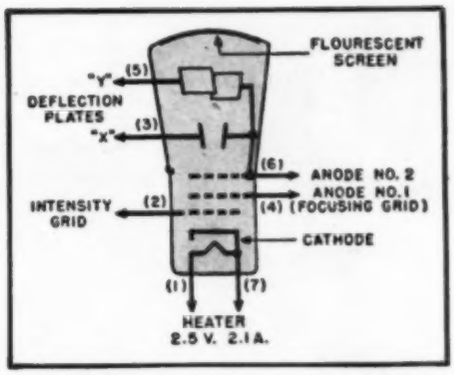


Fig. 2. Illustrating the relative positions of the various elements which make up the 3AP1 cathode-ray oscilloscope tube.

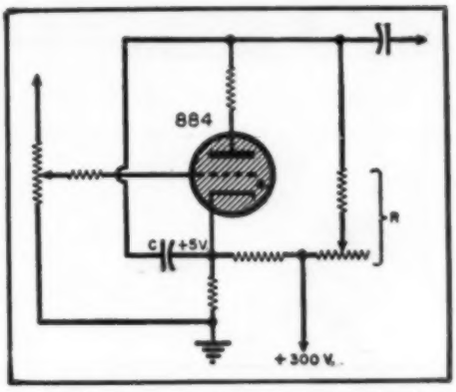
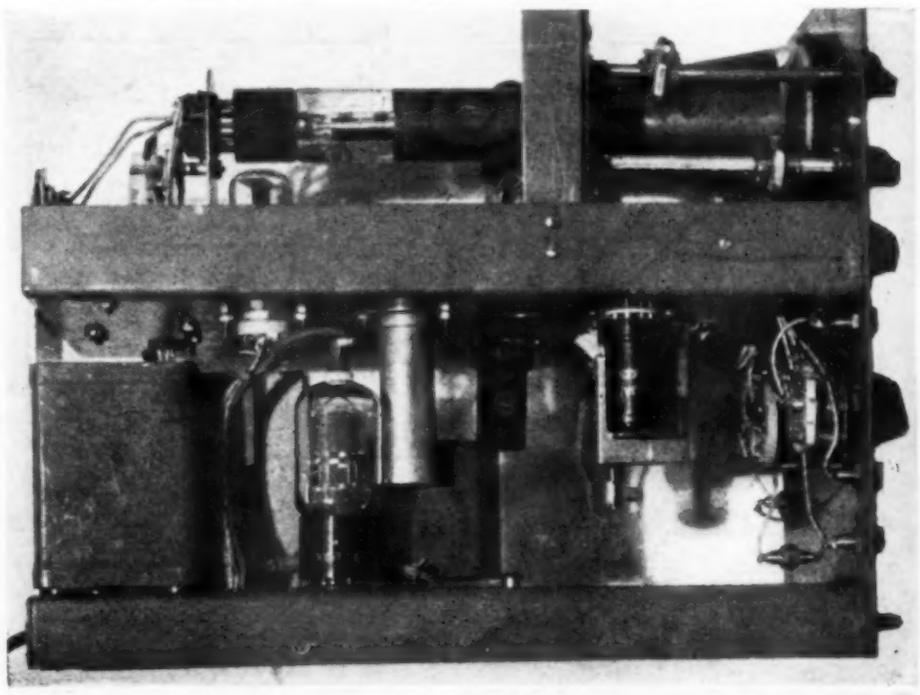


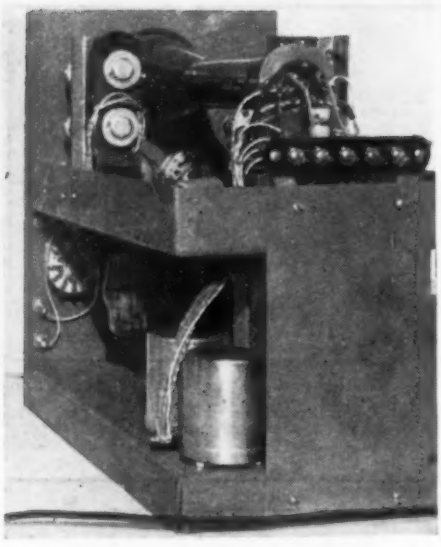
Fig. 3. Diagram of scope sweep circuit.

will be determined by the use to which we intend to put the oscilloscope. If we are interested in audio frequencies only, say from 20 to 50,000 cycles-per-second, the amplifier, Fig. 1, will suffice. It will still have some gain at 1 megacycle, although it would be better to feed a frequency this high directly to the deflection plates.

If you are interested in radio frequencies in the order of a megacycle

Side view of completed instrument with cover removed to show placement of parts.





Rear view of completed oscilloscope.

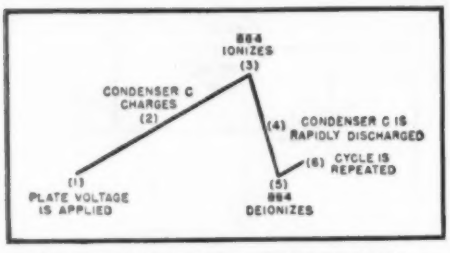


Fig. 4. Wave shape of sweep circuit.

and of an amplitude of five volts or less, then a more extensive Y axis amplifier will be necessary. If the proper display of square waves of high recurrence rate is desirable the response should be flat to at least a megacycle.

The conventional methods of controlling amplitude are unusable at megacycle frequencies because of the input capacity of the tube, combined with the series resistance introduced when the amplitude control is in intermediate position. A much superior system consists of a cathode follower and a frequency compensated attenuator. A potentiometer in the cathode circuit of the cathode follower provides continuous variable output. Fig. 5 shows the circuit. The amplifier which follows the cathode follower must fall in the video amplifier class, being flat from 20 c.p.s. to a megacycle or more.

This means not only careful design but extreme care in construction, as wiring capacity can have a profound effect on response. As a matter of fact, a carelessly wired video amplifier may only go to 500 kc., whereas, a properly wired one will go to over two megacycles!

Every wire in the grid or plate circuit must be kept above the chassis to avoid additional capacity. The output capacity is high enough as it is, as it consists of the output capacity of the tube, the capacity of the deflection plates of the cathode-ray tube, plus the wiring capacity. The effect of this total capacity can be reduced by lowering the load resistor in the amplifier tube's plate circuit. This lowers the circuit impedance.

We may also resort to inductive peaking to increase the response. Simply stated, we pick an inductance which resonates with the total capacity at a frequency above which the response has fallen off substantially. The effect of the inductance is to increase the load impedance gradually at the frequency at which the response starts to fall off, until its resonant frequency is reached. Beyond this point we are on the capacitive side of the resonance of the combination coil and capacitance and the response will fall off rapidly. The formula for computing this inductance is $L = KR^2C$. L is the inductance in henries, R is the resistance in megohms, C is the capacity in microfarads and K is an assumed constant, usually between .42 and 0.5.

Of course, to properly use this formula you must know the total capacity in the plate circuit. All these capacities can be found in tube manuals but the circuit capacity must either be measured or assumed. To lower the effect of this capacity we have lowered the plate resistance in the tube's plate. This also lowers the tube's gain, so we will probably need another stage. This puts quite an additional drain on the power supply, not to mention additional filtering and bypassing, so its necessity must be weighed by the individual constructor.

The power supply for our scope must include two d.c. voltages. First, a well filtered 300 volt supply to run the amplifier and the sweep circuit —a 60 milliampere transformer will suffice; second, a supply for the purpose of providing proper accelerating voltages for the cathode-ray tube. This latter supply has an output of about 1000 volts at 2 milliamperes. *This is a dangerously high potential and should be handled with due caution.*

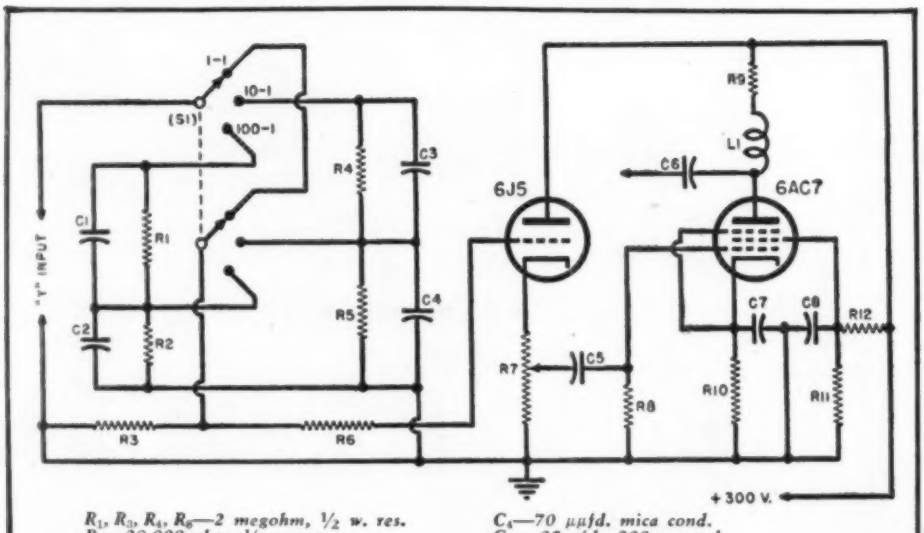
The wiring in the high voltage circuit should be done with well insulated wire. The focus and intensity pots must not be mounted directly to metal but mounted on a piece of bakelite which can then be supported on the chassis. The photographs show this item of construction.

A separate 2.5 volt winding must be provided for the 3AP1 tube, as the cathode is connected to the filament within the tube and the cathode is 1000 volts above ground. A 2.5 volt winding must be provided, also, for the high voltage rectifier, the 2X2. In addition we must provide a filament winding for the low voltage rectifier and a filament winding of 6.3 volts for the amplifier and sweep tube. This is quite an array of windings, but the *Allen B. DuMont Laboratories* (Passaic, N. J.) can supply all these windings on one transformer for about ten dollars. If you desire, two receiver power transformers plus an extra 2.5 volt filament transformer can be used. The filament transformer supplying the 2X2 tube must be insulated for at least 1500 volts, and preferably 2000 volts. This is also true of the winding supplying the 3AP1 and the transformer which supplies the high voltage.

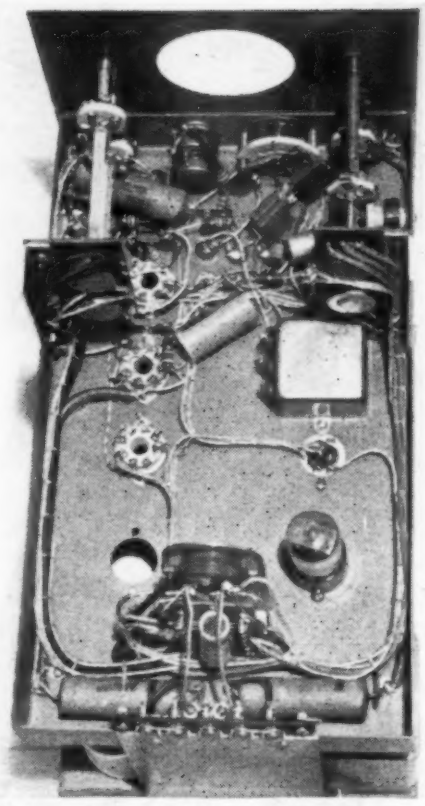
Centering voltage is obtained by applying equal amounts of positive voltage from the low voltage supply and a negative voltage from the high voltage supply across the centering pots so that the trace may be shifted up or down and to either side.

The way that the chassis is arranged was carefully planned. The upper chassis was made from 1/16" soft iron. This provides good magnetic shielding from the power transformers. This is necessary as the 3AP1 is very sensitive to magnetic deflection from an external magnetic field.

Fig. 5. Circuit diagram of wideband Y axis amplifier and attenuator.



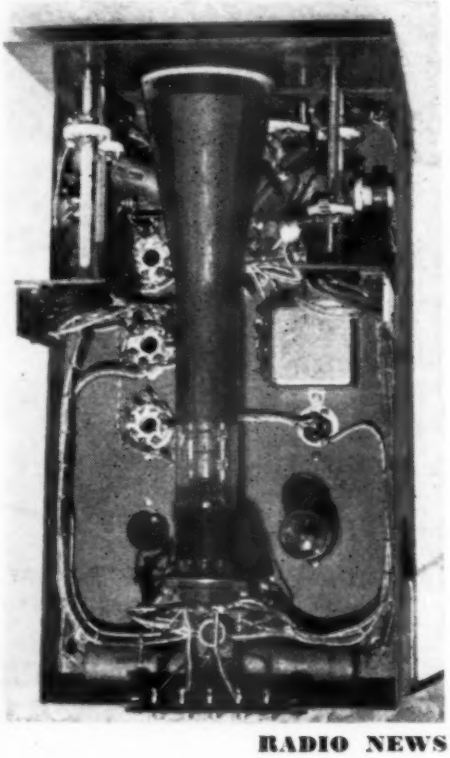
R_1, R_3, R_4, R_6—2 megohm, 1/2 w. res.
R_2—20,000 ohm, 1/2 w. res.
R_5—200,000 ohm, 1/2 w. res.
R_6—100 ohm, 1/2 w. res.
R_7—1000 ohm, w.w. pot.
R_{10}—200 ohm, 1/2 w. res.
R_{11}—3000 ohm, 1/2 w. res.
R_{12}—10,000 ohm, 1/2 w. res.
C_1, C_2—3-12 μμfd. mica cond.
C_3—.001 μfd., 400 v. cond.
C_4—70 μμfd. mica cond.
C_5—.25 μfd., 200 v. cond.
C_6—.1 μfd., 400 v. cond.
C_7—10 μfd., 50 v. elec. cond.
C_8—10 μfd., 350 v. elec. cond.
S_1—S.p.3 pos. rotary sw.
Values for L_1 and R_9 will depend upon bandwidth desired and wiring capacity. For a 2 mc. bandwidth, L_1 and R_9 are approximately 100 μh. and 5000 ohms respectively.



Top view of oscilloscope. The case and cathode-ray tube have been removed to show relative position of parts. Note in particular that the top chassis has been mounted in an inverted position.

Furthermore, the method of mounting the tubes upside down on the upper chassis provides very good shielding from the power supply wiring and also effects short leads from the tubes to the panel controls and from the tubes to the deflecting plates of the cathode-ray tube. Standard commercial chas-

Same view as above with the exception that the 3" cathode-ray tube is shown mounted in its proper position in unit.



Writing with your voice

Years ago Alexander Graham Bell dreamed of "a machine that should render visible to the eyes of the deaf, the vibrations of the air that affect our ears as sound." He never realized that dream, but his researches led to the invention of the telephone.

Today Bell Telephone Laboratories have turned the dream into a fact – translating the spoken word into readable pictures.

By this new invention of the Laboratories, the talker speaks into a microphone. Vibrations of the voice are unraveled through electronic circuits, and then are reassembled as luminous patterns which travel across a screen. Each syllable of sound has a distinctive shape and intensity.

Science unravels speech

Visible speech is still in its infancy, and is not yet available to the public. But educators of the deaf are now evaluating it. Indications are that the deaf can learn to read the patterns and, by comparing the patterns their own voices make with the patterns of correct speech, can improve their diction.

Patterns of visible speech also provide a means for analyzing and recording sound in the study of phonetics and of languages. Eventually, visible speech may make possible visual telephony for the deaf.

This is but one of many contributions by Bell Telephone Laboratories to the understanding and control of sound.

BELL TELEPHONE LABORATORIES *EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE*

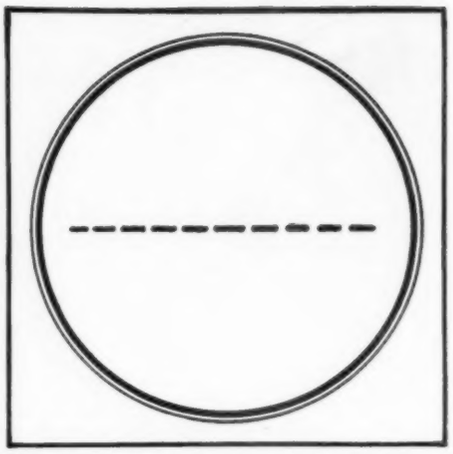


Fig. 6. Horizontal sweep with calibrating wave applied to intensity grid. This wave may be applied direct to intensity grid, or through Z axis amplifier. See Fig. 7.

sis and panel may generally be used.

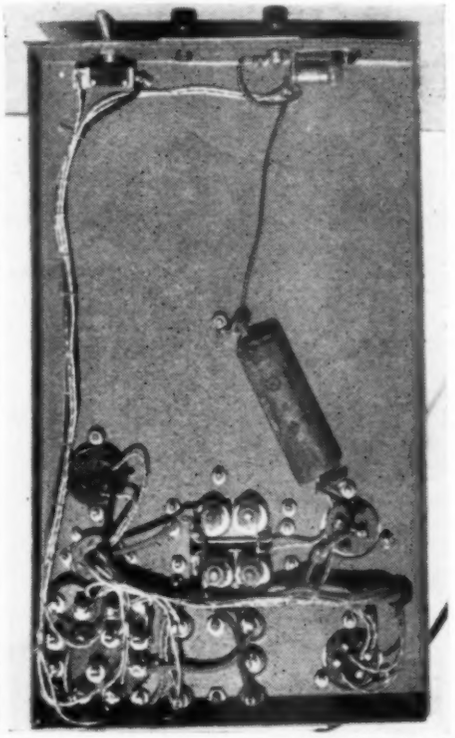
This model used two chassis 8″ x 14″ x 2″, although these dimensions can be changed somewhat without disturbing the operation appreciably. The panel should be of iron or steel. The panel on the back provides access directly to the deflection plates when the jumpers are removed. This facilitates d.c. voltage measurements and introduction of high voltage, high amplitude waveforms directly to the deflection plates. The inputs are made to tip jacks, although the constructor can use binding posts if he so desires.

The front panel in the present model has engraved control labels. The proper lettering can be done with black or white ink directly on the panel and then given coats of clear lacquer to preserve it.

The photographs show clearly the manner of construction and the lay-

(*Continued on page* 163)

Under-chassis view of power supply.



Two Ghirardi Books that teach you to

REPAIR ANY RADIO EVER MADE

A. A. GHIRARDI
Let Radio's foremost technical author help you start training NOW for a profitable future.

HERE'S HOW TO LEARN TO BE A PROFESSIONAL REPAIR EXPERT ... AT HOME! without an Instructor!

HERE'S HOW TO MAKE 9 OUT OF 10 RADIO TROUBLES EASY TO REPAIR

Only $5.

YOUR MONEY BACK

Order either or both of these big books now! Use coupon! Read them for 5 days. Then, if not more than satisfied, return them AND EVERY CENT OF YOUR MONEY WILL BE CHEERFULLY REFUNDED — no questions asked!

MODERN RADIO SERVICING

The Only Complete Book on Modern *Professional* Radio Repair

A. A. Ghirardi's MODERN RADIO SERVICING is the only single, inexpensive book that gives a complete, easily understood course in radio repair work by modern professional methods. Written so simply you can understand it easily without an instructor. Read from the beginning, it takes you step by step through all phases of the work. Used for reference by busy servicemen, it serves as a beautifully cross-indexed book for "brushing up" on any type of work that puzzles you.

TEST INSTRUMENTS—TROUBLESHOOTING—REPAIR

MODERN RADIO SERVICING includes a thorough explanation of all Test Instruments. Tells exactly how they should be used, where, when, and why. Even gives all data for the construction of test equipment in case you want to build your own! Tells how to make preliminary trouble checks on complicated jobs. How to analyze ANY circuit scientifically. How to interpret instrument readings. How to test and repair components, how to make installations, adjustments, etc.—and how to Start a Successful Service Business of Your Own! Nothing is omitted or condensed. It is a book of "Know How" that will help fit you for the really big paying jobs in all sorts of Radio-Electronic-Television repair—because it teaches you RIGHT! 1300 pages. 720 Self-Test Review Questions. 706 helpful illustrations and diagrams. Only $5 complete ($5.00 foreign) on our 5-DAY MONEY-BACK GUARANTEE.

RADIO TROUBLESHOOTER'S HANDBOOK

What to Do—How to Do It—In Making Specific Repairs on OVER 4800 MODELS

Radio servicemen everywhere say that Ghirardi's big 744-page, manual-size RADIO TROUBLESHOOTER'S HANDBOOK helps them turn out *twice as much work in a given time!* Beginners and those who like to fix radios for themselves and for friends find this giant Handbook a quick, easy way of locating and repairing radio receiver troubles without expensive shop equipment. 9 times out of 10 it tells exactly how to repair a set—without any elaborate testing whatever.

NOT A STUDY BOOK!

There's no magic about it. Just plain, common sense! Over 400 pages of the Handbook contain carefully indexed listings of common trouble symptoms, their causes and remedies for over 4800 home receivers, auto radio, and record changer models of 202 manufacturers. Just look up the make and model you want to repair. Then follow clear, easy instructions that the Handbook gives you. Shop tests have shown that 9 jobs out of 10 can be repaired in this manner. Tedious testing is eliminated. Service work becomes a lot easier. You handle two jobs in the time normally required for one.

300 PAGES OF EXTRA HELP!

In addition, 300 pages contain service hints; i-f alignment peaks for over 20,000 superhets; transformer trouble data; the most complete tube information you've ever seen; and hundreds of graphs, diagrams, charts, color codes, etc. Everything is carefully indexed so you can find what you want QUICKLY. Hundreds of users say the HANDBOOK has paid for itself by the time it saved them on *the very first job.* $5 complete ($5.50 foreign) on our 5-DAY MONEY-BACK GUARANTEE.

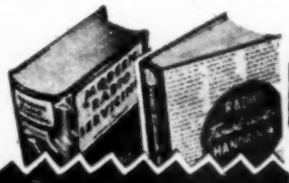
SPEED-UP

SERVICE WORK WITH GHIRARDI GADGETS

Ghirardi Gadgets troubleshoot radio sets with lightning speed. Just flip a card, and there before you are the "remedies" and "tests" to make for whatever "trouble" symptoms you find!

HOME RADIO GADGET—Spots 400 different troubles in Power Unit, Receiver Circuits Proper, Tubes, Loudspeaker, Antenna, Ground, Batteries, etc. Covers such symptoms as "Hum," "Weak," "Noisy," "Inoperative," "Intermittent Reception," "Fading," and many more. Tells what tests to make. Suggests the remedy for each trouble.
Only **50c**

AUTO-RADIO GADGET—Spots 444 special auto-radio troubles in all possible trouble-sources for 11 common symptoms including "Hum," "Weak," "Noisy," with and without car and engine at rest, "Noisy" when car is coasting with ignition off, "No Reception," "Intermittent," "Fading," "Distortion," and "Oscillation." Only **50c**



MONEY-SAVING OFFER

Let Ghirardi's RADIO TROUBLESHOOTER'S HANDBOOK save you time on common radio jobs. Let MODERN RADIO SERVICING train you in scientific servicing "Know How." Get BOTH big books at special price of only $9.50 ($10.50 foreign). Use coupon today.

MAIL ORDER *rush coupon!*

Dept. RN-37, Murray Hill Books, Inc.,
232 Madison Ave., New York 16, N.Y., U.S.A.

☐ Enclosed find $.....for books checked; or ☐ send C.O.D. (no foreign C.O.D.'s) for this amount plus postage. If not fully satisfied, it is understood I may return books within 5 days for refund.

☐ RADIO TROUBLESHOOTER'S HANDBOOK, $5 ($5.50 foreign)
☐ MODERN RADIO SERVICING $5 ($5.50 foreign)
☐ **MONEY-SAVING COMBINATION OFFER**—Both the Handbook and Modern Radio Servicing—over 2040 pages—only $9.50 for the two ($10.50 foreign).
☐ HOME RADIO GADGET, 50c ☐ AUTO RADIO GADGET, 50c

Name.....

Address.....

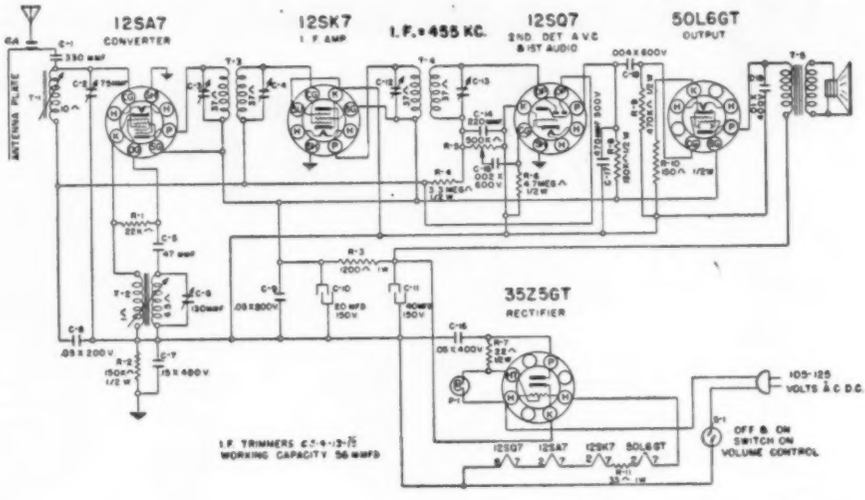
City & Dist. No.....State.....

YOU'LL NEVER GO WRONG ON A GHIRARDI BOOK!

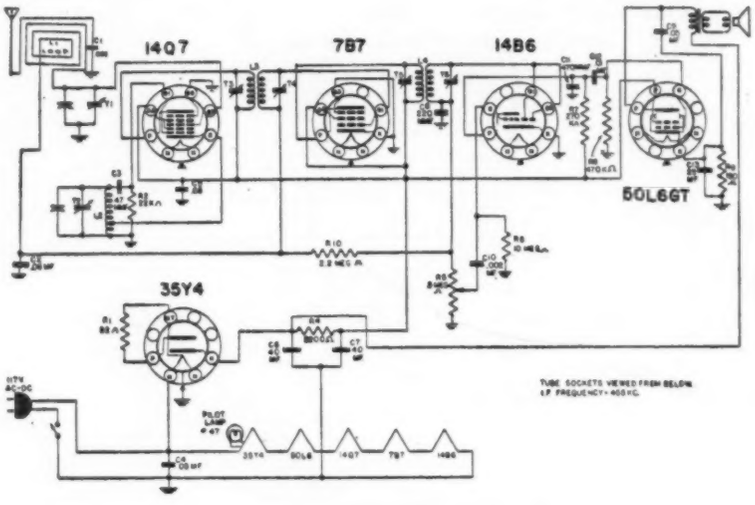
the RN CIRCUIT PAGE

(FOR PARTS LISTS SEE PAGE 86)

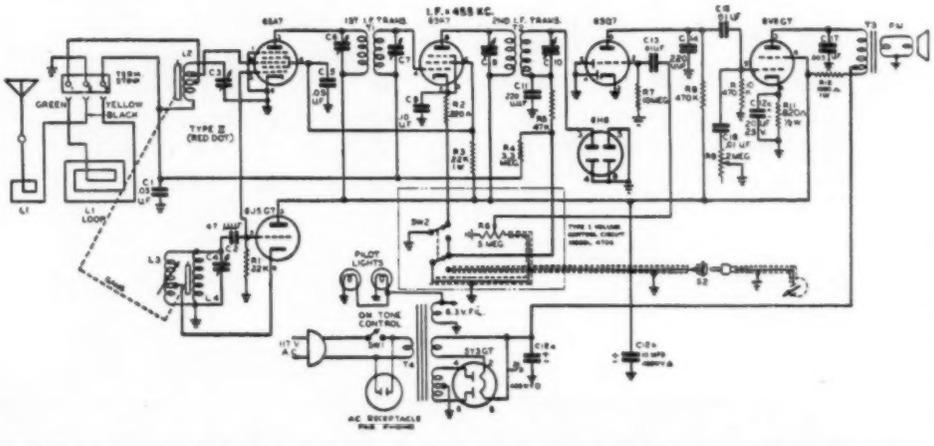
RADIO NEWS, MARCH, 1947 — **GRANTLINE MODELS 500, 501**



RADIO NEWS, MARCH, 1947 — **AIR KING MODEL 4608A**

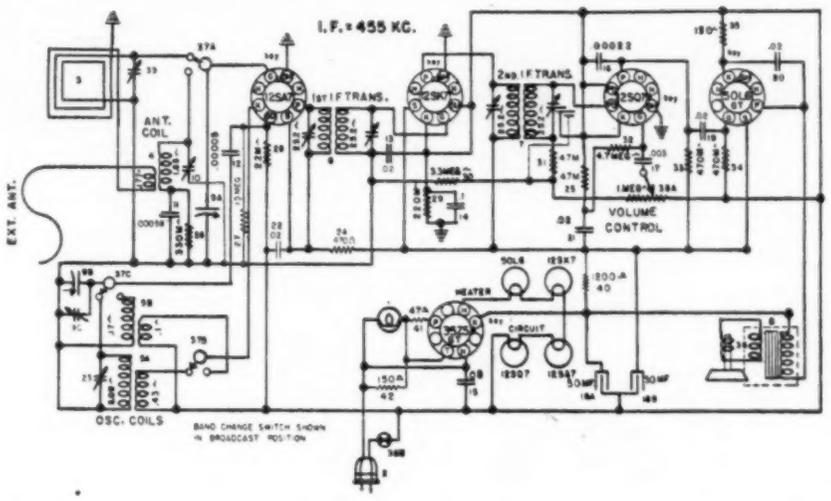


RADIO NEWS, MARCH, 1947 — **MAJESTIC MODELS 7C432, 7C447**

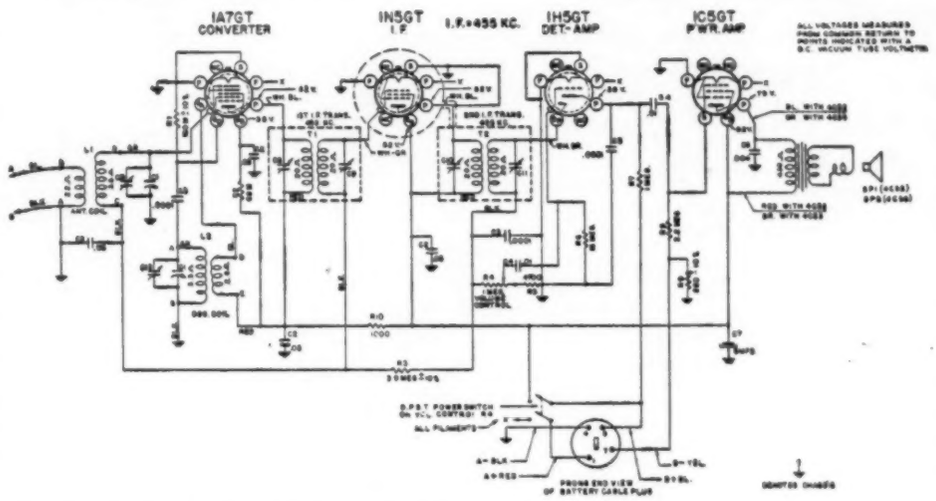


Here, and on following pages, are circuit diagrams and parts lists of many new postwar radio receivers. Radio News will bring to you other circuits as quickly as possible after we receive them from manufacturers.

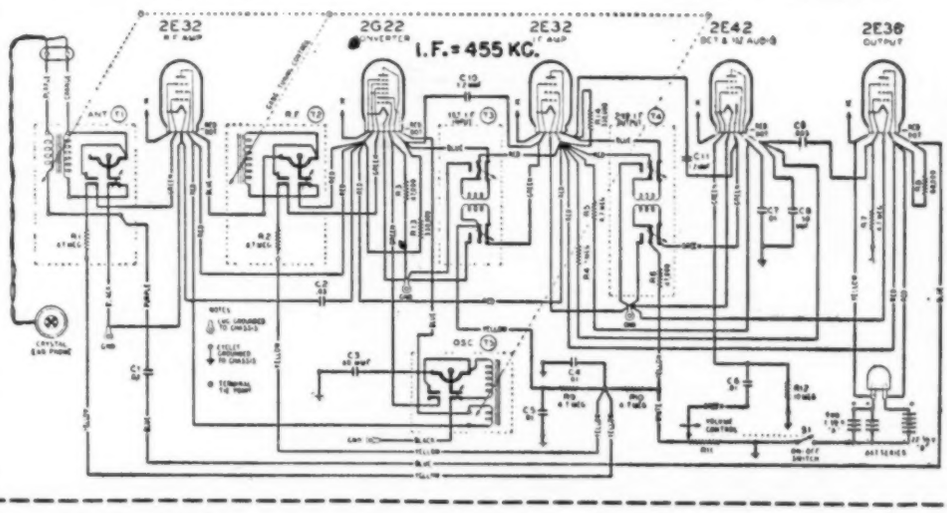
RADIO NEWS, MARCH, 1947 — CROSLEY MODELS 56XTA, 56XTW



RADIO NEWS, MARCH, 1947 — ZENITH MODELS 4K016, 4K035



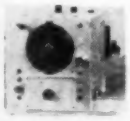
RADIO NEWS, MARCH, 1947 — BELMONT BOULEVARD



BIG SCOOP! WESTERN ELECTRIC AIRCRAFT SURPLUS

ALL OF THE RECEIVERS AND TRANSMITTERS LISTED BELOW ARE IN GOOD CONDITION. THE RECEIVERS ARE NEW, THE TRANSMITTERS ARE USED BUT GUARANTEED PERFECT. ORDER SURPLUS WITH CONFIDENCE FROM McGEE.

RECEIVERS



These Army surplus aircraft receivers may be operated from a 24 volt AC filament supply and any low power 250 volt B supply; or the tubes changed to the 6 volt type. There is plenty of room for a power transformer and rectifier tube; in place of the dynamotor. This receiver is very selective and sensitive; has RF stage and BFO. Made by Western Electric and you never saw finer wiring. Offered complete with tubes; 12K8, 3-12SK7, 12SR7 and 12A6, but less 28 volt dynamotor. Specify the frequency you desire. We have about 1500 available.

BC-454-B Superhet Receiver 3 to 6 MC. Your Cost **$9.95**

BC-453-B Superhet Receiver 200 to 500 KC. Your Cost **$9.95**

BC-455-B Superhet Receiver 6 to 9 MC. Your Cost **$9.95**

Very special: All 3 of the above receivers; with shock mounting rack..... **$27.95**

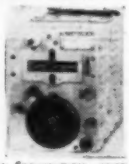
28 volt dynamotor (snaps on receiver chassis) **$1.95**. 3 for..... **$5.50**
receiver shipping weight 8 lbs.

IF YOU DESIRE ANY OF THE ABOVE RECEIVERS WITHOUT THE TUBES DEDUCT $3.00 per set.

TRANSMITTERS

This is the Ham's Delight—Army Aircraft Transmitters

BC-457-A 4 to 5.5 MC
BC-458-A 5.3 to 7.5 MC



This really fits the ham's dream. Ideal for a 55 watt transmitter with 575 volts at 250 MA plate supply, or VFO to drive a high power rig. It's a companion unit to the 454-455-453 series aircraft receivers. Made by Western Electric and really rugged. The oscillator will hold the frequency, even under rough operating conditions. Has 1625 M. O. and 2-1625 (807) in parallel as final P. A.; or buffer to feed into a high power rig. Built in crystal dial calibration checker. Antenna loading inductance. Complete conversion data to VFO or FM oscillator is covered in CQ magazine; May '46 issue. Why not use this for your VFO? It's a real buy. 1000 to sell; at the ridiculous price of $14.95; with tubes.

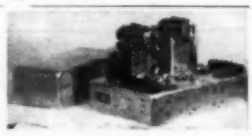
BC-457-A Transmitter 4 to 5.5 MC. Complete with 4600 KC crystal.....Your Cost **$14.95**

BC-458-A Transmitter 5.3 to 7.5 MC. Complete with 6200 KC crystal.....Your Cost **$14.95**

Special. Both of above on shock mounting rack **$28.95**

2" 0 to 10 antenna current meter in case; ideal for loading above transmitter. .....Each **$2.95**
transmitter shipping weight, 12 lbs.

BC-456-E Western Electric Modulator Unit



Companion unit of BC-457-A and BC-458-A. Complete with 1225 and VR150 and 1625. Gives necessary output to modulate above transmitters. We have a few more modulators than transmitters and are offering them at a ridiculously low price. You can salvage many parts from this modulator unit. Offered complete with tubes. Very special **$4.95**. 3 for **$13.95**.
Dynamotor 28 volts input; 250 volts 160 MA output continuous. Snaps on modulator **$3.95 each; 3 for $10.95.**

450 M. C. BC-645 15-TUBE I. F. F.

EASILY CONVERTED TO A VOICE—CW—TRANSMITTER—RECEIVER

★ **Factory Printed—Conversion Diagram**
★ **New ★ Pictured with Cover Removed**
★ **With 15 Tubes. NET $16.95. Two for $32.90**

ANOTHER HOT WAR SURPLUS SCOOP

ARMY BC-645 I.F.F. UNIT. Net $16.95. Early in the war, when radar picked up a plane, there was no way of knowing whether it was friendly or not. That was before BC-645 was invented. BC-645 sent out a signal that identified the plane as American. It probably saved more lives than any other piece of electronic equipment made. With some modifications the set can be used for 2-way communication, voice or code, on the following bands: ham band 420-450 mc., citizens radio 460-470 mc., fixed and mobile 450-460 mc., television experimental 470-500 mc. Equipment capable of doing the jobs of the modified set sells for hundreds and hundreds of dollars. The 15 tubes alone are worth more than the sale price. 4-7F7, 4-7H7, 2-7E6, 2-6F6, 2-955 and 1-We316A. It now covers 460 to 490 mc. Each BC-645 is shipped with a Belmont factory printed conversion diagram, showing how to make AC power supply modulator and how to make Transmitter and Receiver changes. Most Hams and experimenters already have the few parts necessary. New BC-645 with tubes less power supply. Shipping weight 20 lbs.

SENSATIONAL SURPLUS BUY

BC-654-A. Transmitter-Receiver 12 watts CW. 8 watts phone. 3800 to 5800 KC $19.95. Used but in apparently good order. Offered with 3-307A tubes but less receiver tubes. The 7 tube superhet receiver has 2 RF stages. Designed for 1½ volt octal tubes. Could be converted to heater tubes. Has built in 200 KC crystal calibrator. The 200 KC crystal and 0-3 RF thermocouple ammeter and 3-307A tubes are worth the price we are asking for the whole unit. First come first served. BC-654-A transmitter-receiver less power supply .....Net **$19.95**
BC-654-A Complete with all tubes and spare tubes. Net **$24.95.** 2 for **$47.50.**

PARTS SALVAGE SPECIAL

ARMY BC-745 Power Supply (Vib. Type) THIS IS A HOT SALVAGE SPECIAL. A multitude of usable radio parts. Transformer, chokes, relays, condensers, 4" Alnico 5 PM speaker, resistors, cables, etc. All housed in a handy usable portable hinged metal case. These units are new and worth lots more than our price. Complete, less vibrators. Shipping weight 20 lbs. 2000 to sell **$2.95** each.

4-TUBE AMPLIFIER ONLY 99c

4 TUBE AMPLIFIER (2-7C5, 7F7, 7Y4). Used as electronic supercharger control, 110V, 400 cycle. Contains: power trans., 7 condensers (mica and oil), 7 resistors, 4 loctal sockets plus other components worth many times the price. Black crackle finish, fitted slide-in chassis. 8¾"x4½"x3¾". Less tubes.
Net **99c**

METAL BATHTUB PAPER CONDENSERS

.05 MFD. 600V		2 MFD. 600V	
.1 MFD. 600V		2 x .1 MFD. 600V	
.25 MFD. 600V		3 x .1 MFD. 600V	
.5 MFD. 600V		2 x .25 MFD. 600V	
1 MFD. 600V		2 x .1 MFD. 1000V	

19c each. 10 ASSORTED FOR..... **$1.49**
These are all Gov't stock; oil filled; paper top or side; insulated lug connections.

TRANSMITTING MICAS

.00005 MFD. 1500V	$0.29	.004 MFD. 2500V	$0.39
.0001 MFD. 1500V	.29	.01 MFD. 2500V	.39
.0005 MFD. 1500V	.29	.00005 MFD. 5000V	.49
.001 MFD. 1500V	.29	.0001 MFD. 5000V	.49
.002 MFD. 1500V	.29	.0005 MFD. 5000V	.49
.006 MFD. 1500V	.29	.002 MFD. 5000V	.49
.002 MFD. 2500V	.39	.006 MFD. 5000V	.49

These are Sangamo, CD, Solar. All new, unused stock. Worth many times the price.

G. E. PYRANOL OIL FILLED TRANSMITTER CONDENSERS. HEAVY METAL CANS. PORCELAIN INSULATORS. GOV'T STOCK

8 x 8 MFD.	600V	$1.49		Round Can	
8 MFD.	600V	1.19	2	MFD. 1500V	$1.49
10 MFD.	600V	1.39	1	MFD. 3000V	1.95
2 MFD.	1000V	.99	8	MFD. 2000V	3.95
	Round Can		3	MFD. 3000V	3.95
4 MFD.	600V	.79	3	MFD. 4000V	4.95

These are all new stock of best makes, such as G. E. and CD. Our prices are about ¼ of regular net.

SMALL OUTPUTS

Clamp on Type as Used in Original Equipment.

2,000 ohm for 50L6	$0.59	10,000 ohm	$0.59
7,000 ohm	.59	25,000 ohm Push Pull	.69

25,000 ohm especially good for battery sets.

Double 40 Watt Fluorescent Ballast made by General Transformer **$3.98**

McGEE'S RED HOT SPECIALS

JAN OR REGULAR BRAND TUBES CARTONED OR UNCARTONED

SPECIAL at .49

30/44	42	6D6
76	41	6C6
37	27	1S5
5Y4G	26	1T4
5Y3GT	6H6	35S4
6C8G	6AC7	1L4
6F8G	6SH7	3A4
1633	56	1R5
1634	6B4G	
12SN7	80	
6SN7	6K7	
6SD7	12J5	

SPECIAL at .69

1J6	6F6	1V
1D5	6Y6	75
1B4	12SF7	77
30	12SQ7	24
5Z3	46	78
6SA7GT	38	12SA7
6SK7GT	6SJ7	12SK7
6SQ7GT	6G6	12SQ7
5U4	6C5	12SR7
5T4	12Z3	12A6
6K6		

VERY SPECIAL JAN 6L6M ..... **.99**

SCOOP IN RADIO TUBES
6 & 12 VOLT LOCTAL TUBES

7A4	7B7	7B5	7J7	7E6	7Y4	**79c**
7A6	7C7	7B6	7R7	7E7	7Z4	**EACH**
7C5	7Q7	7C6	7V7	7A7	7H7	
14Q7	14C5		14B6	35Y4		**79c**
14A7	14J7		14B8			**EACH**
14H7	14R7					

1½ VOLT LOCTAL TUBES

1LD5 1LB4
1LH4 1LN5 **99c** EACH
1LA4

1LA6 1LC6 **$1.49** EACH

Regular net on these tubes is $1.81. These tubes are all Sylvania.

Save 30 to 70% on Vibrators
WAR SURPLUS AND REGULAR CARTONED

Midget 4 prong, for Ford sets	$1.49
Delco off set 4 prong 6 volt	1.79
Mallory 5 prong sync. 6 volt	1.95
Oak stan. 6 prong sync. 6 volt	1.95
Utah SI'-55, off set 5 prong sync. 6v	2.59
Utah SP-62 reversible 6 prong sync	2.59
Sync. unit only, long leads 6 volt	1.69
Utah SL-5 sync. unit with buffers	2.59
Midget Radiart 6 prong sync	1.49
32 volt standard 4 prong	1.49
General Elec. 7 prong 2 volt sync	1.95
Heavy duty 6 prong sync. for 30 watt 6 volt amplifiers. Special	2.95

SENSATIONAL 4-PRONG VIB. SCOOP

Genuine UTAH NP-42 4 prong 6 volt vibrator. This is the reg. type and size, just like you use every day. Fits Philco and many others. Very special. Net **$1.29**

Mallory Sync. Vibrator Unit Save 75%
Standard size replacement, 6 volt sync., vibrator unit; long leads. Ideal for all types of replacements. Easily fits in any can. Net..... **$0.99**

McGEE SPECIAL TUBULAR ELECTROLYTIC CONDENSERS

8	MFD 450 V PAPER TUBULAR	$0.29
16	MFD 450 V PAPER TUBULAR	.39
8–8	MFD 450 V PAPER TUBULAR	.49
16	MFD 150 V PAPER TUBULAR	.29
40	MFD 150 V PAPER TUBULAR	.39
20–20	MFD 150 V PAPER TUBULAR	.39
40–30	MFD 150 V PAPER TUBULAR	.49
100	MFD 25 V PAPER TUBULAR	.24

These are first class electrolytics. Guaranteed 1 year.

McGEE SPECIAL PAPER TUBULARS
600 V TUBULAR

.001	$0.07	.02	$0.07
.008	.07	.05	.08
.01	.07	.1	.09

ASSORTMENT OF 100: TAKE OFF 1c EACH

FINEST QUALITY TUBULAR ELECTROLYTICS IN ALUMINUM CANS. WITH PAPER INS. SLEEVES.

8 Mfd. 450 volt midget tubular	$0.39
8x8 Mfd. 450 volt midget tubular	.69
16 Mfd. 450 volt midget tubular	.64
20x20 Mfd. 150 volt tubular	.59
40x20 Mfd. 150 volt tubular	.69
50x30 Mfd. 150 volt tubular	.79

We guarantee these condensers for 1 year and are as fine as any produced. Money back guarantee.

40 MIL STANCOR POWER TRANSFORMER

Flush mounting 6.3, 5 volts. Special..... **$1.98**

12" G. E. SPEAKER

7 oz. Alnico 5. Beats anything you ever heard.
List $16.50.....Net **$9.50**

10" G. E. SPEAKER

7 oz. Alnico 5.
List $13.50.....Net **$7.50**

SCOOP ON ALNICO—5 PM SPEAKERS

4" 1 oz.	$1.49
5" 1 oz.	1.59
5" 1½ oz.	1.69
6" 1½ oz. square	1.95
6½" 1½ oz. round	1.95
8" 8 oz. Alnico 3	2.95

SPECIALS ON BATTERIES

PORTABLE BATTERIES

GENERAL V30B
GENERAL V30A **SPECIAL 79c EACH**
GENERAL V30AA

General 60DL-11L AB Pack. Very Special $3.95

These batteries were made in June and July of '46. Are perfect. Have sold over $10,000 worth. Remember, farm packs weigh 25 lbs. each.

SPECIAL 500,000 ohm volume control with switch and 2½" shaft $0.59

SMALL SLIDE RULE DIAL

All assembled. Ready to mount on top of 5" speaker.
Special **$0.39**
Small Universal Output Trans. ..... **.99**
Medium Universal Output Trans. **1.29**
Large Universal Output Trans. **1.49**

WRITE FOR BARGAIN FLYER

When ordering, Canadian and American possession customers send full remittance and ample postage.

McGEE RADIO COMPANY •

Send 20% Deposit — Bal. Sent C.O.D.
1225 McGEE ST., KANSAS CITY, MISSOURI

McGEE OFFERS YOU THE BEST VALUES IN RADIO AND PHONO-KITS

EVERY KIT COMPLETE • FACTORY ENGINEERED • SIMPLIFIED DIAGRAMS

During the past 15 years, we have designed and sold thousands of complete radio kits. We know that it takes matched parts and correctly designed circuits to please you. We are now going a step further, by offering you, not only schematics, but parts layout sheets. Photographs of the top and bottom of a completed radio kit. This assures you of correct and rapid assembly. All chassis are punched and designed to fit their respective cabinets. All parts, resistors and tubes are furnished, nothing else to buy. Order with confidence.

RADIO-PHONO COMB. KIT

Build this beautiful portable combination radio phonograph. We furnish everything. Beautiful two tone portable case, latest rim drive phono motor, Astatic crystal pick-up. All parts to build high quality 5 tube AC-DC radio. Tunes broadcast 550 to 1650 KC, has tone control, loop antenna, 6" Alnico 5 PM speaker. Tubes 12SA7, 12SK7, 12SQ7, 50L6 and 35Z5. Simple diagram furnished. Kit Model RP-12.....Your Cost **$29.95**

WALNUT CABINET RECORD PLAYER

Beautifully made, highly polished walnut cabinet with hinged lid. Plays 10" records with lid closed. Latest rim drive phono motor and high output. Astatic crystal pick-up. High power JT-5, push-pull 3 tube AC-DC phono amplifier (wired and tested). Heavy duty 5" Alnico 5 PM Speaker. Single record player kit Model WL-3.....Your Cost **$19.95**

SMALL RADIO-PHONO KIT

After carefully designing the record player and cabinet shown above (Model WL-3), we decided that it should also be offered as a radio-phono combination. The cabinet is both attractive and small (12x12x8). The radio kit part of this unit is similar, except for the dial, to our Kit Model KP-48 shown in column 3 of this page. We furnish all parts, tubes, phono motor, pick-up, etc. Easy to follow diagram.
Kit Model WL-3R. Net.....**$29.95**

New 8 tube P. A.—Radio Kit PRK-8

Build this High-Fi Radio-Amplifier

- **Standard Broadcast Superhet 550 to 1650 KC**
- **New Positive Drive Permeability Tuner**
- **12" Dynamic Speaker**
- **Push-Pull 6V6 Output Stage 15 Watts**
- **456 KC I. F.'s**
- **Dual Tone Controls (Bass and Treble)**
- **Phono and Crystal Mike Inputs**
- **A Fine Power Amplifier and Radio Kit**
- **All Parts and Simple Easy-to-Follow Diagram Furnished**

Here is something new in radio. A real 15 watt power amplifier, with bass and treble controls. Has extra gain stage for crystal or dynamic mike. And on the same chassis, a standard superhet radio receiver. We furnish all parts, knobs, escutcheon plate and tubes: 6SA7, 6SK7, 6SR7, 6SN7, 6SJ7, 2-6V6, and 5Y3. No Cabinet. An actual photo of top and bottom of completed chassis makes wiring and assembly very easy.
Model PRK-8. Your Net.....**$24.95**
Crystal Mike and Stand $7.95 extra

20 WATT UTILITY AMPLIFIER KIT

Build this 20 watt utility 110 volt AC, 20 Watt power amplifier. Ready punched aluminum chassis, size 12 x 6 x 2½ inches. Has two input circuits, one mike and one phono. Mike stage has 135 DB gain, for crystal or dynamic mike. Has bass and treble controls. Designed for use with PM speakers; has 8-16 ohm output transformer. All parts, controls, transformers and easy-to-follow diagram furnished, including tubes: 2-6SN7, 6J5, 2-6L6GA, 5Z3.
Kit Model 20-LX. Net.....**$17.95**
12" G. E. 12 watt Alnico 5 PM speaker, $9.50 extra.
Astatic crystal mike and desk stand, $7.95 extra.

3-WAY PORTABLE KIT

Build this powerful, 5-tube, 3-way portable kit. Operates on 110 volt AC or DC, or self contained batteries. Receives broadcast 550 to 1650 KC. Incorporates a standard superhet circuit with A.V.C. and loop. Has 5" Alnico 5 PM speaker, 2 gang condenser. All parts, batteries and diagram furnished, including tubes: 117Z6, 1R5, 1T4, 1S5 and 3S4. This kit was engineered too late to show a picture of the attractive portable walnut cabinet, which is approx. 7 x 9 x 4½ inches. A real kit. Remember, we furnish everything.
Kit Model 3-ZA. Your Net.....**$17.95**

PHONO-MOTORS—PICKUPS—CART

RIM DRIVE PHONO MOTOR 9" TURNTABLE. SPECIAL.....**$3.95**

LATEST GENERAL INDUSTRIES DUAL SPEED TURNTABLE. MODEL D. YOUR NET..**$15.90**

NEW SHURE GLIDER PICK-UP; NO NEEDLE NOISE. REGULAR $3.50 VALUE. SPECIAL AT.....**$2.29**

NEW CURVED ARM ASTATIC AS USED ON MOST 1946 equipment. Reg. $3.50 value. SPECIAL.....**$2.29**

LATEST IN PHONO-KITS

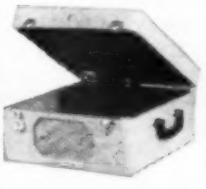
High Power Push-Pull Amps

You can save money by assembling your own record players. All the kits listed below are complete; nothing else to buy. In 15 or 20 minutes any of these kits will be ready to sell to your customers.

*The model JT-5 high power push-pull 3 tube AC-DC amplifier is furnished with all record player kits complete; wired and tested and furnished with tubes and speaker. The push-pull circuit assures good bass response even at low volume. For servicing convenience and connecting to pick-up, a schematic diagram is furnished.

KIT J-15 SINGLE RECORD PLAYER. Attractive ready cut walnut finished cabinet with latest 78 RPM phono motor and light weight crystal pick-up and *JT-5 push-pull AC-DC amplifier and 4" alnico 5 PM speaker. This player will surprise you in appearance and performance.
Kit J-15 Dealers.....Net **$15.95** complete

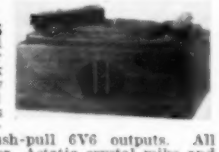
KIT J-16 AUTOMATIC RECORD PLAYER. Beautiful walnut finished, made to fit cabinet; latest single post automatic record changer and *JT-5 high power push-pull AC-DC amplifier (wired and tested) and heavy duty 5" alnico 5 PM speaker. This kit makes a deluxe home record player.
Kit J-16 Dealers.....Net **$29.95** complete
KIT J-16A. Same as J-16 except with leatherette base instead of walnut. Dealers....Net **$26.95** complete



KIT J-17 PORTABLE SINGLE RECORD PLAYER. Attractive tan leatherette covered portable case with latest 78 RPM rim drive phono motor and light weight crystal pick-up and push-pull AC-DC amplifier *JT-5 (wired and tested) and 5" heavy duty alnico 5 PM speaker. A red hot special.
Kit J-17 Dealers.....
..Net **$19.95** complete

KIT J-18 PORTABLE AUTOMATIC RECORD PLAYER. Beautiful portable leatherette case and latest single post automatic record changer and *JT-5 3 tubeAC-DC push-pull amplifier (wired and tested) and heavy duty 6" alnico 5 PM speaker. We have sold hundreds of these to our dealers and they keep coming back for more. A real value. Kit J-18 Dealers.....Net **$33.95** complete

KIT J-19 SINGLE RECORD ATTACHMENT. Attractive walnut finished base with motor cut out, latest 78 RPM rim drive phono motor and light weight, high output crystal pick-up. Easily attached to any radio or amplifier.
Kit J-19 Dealers.....
...Net **$9.95** complete
Model B-4 phono oscillator (fits under base).
Dealers .....Net **$3.69**



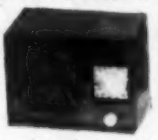
HOME RECORDER KIT J-K6.
Dealers.....Net **$59.95**
Consists of latest General Industries dual speed 33 or 78 RPM record-play-back mechanism. Beautifully made to fit walnut cabinet and a complete kit of parts to build a high quality recording amplifier with push-pull 6V6 outputs. All parts, tubes, 5" PM speaker, Astatic crystal mike and diagram furnished. This amplifier can also be used as a 15 watt PA system. Provisions made to connect 12" PM Speaker. (12" G. E. PM Speaker and wall baffle **$16.95** extra). Net Kit J-K6 **$59.95.**

G.I. RECORDER MECHANISMS

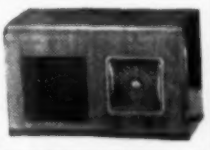
Latest 1947 General Industries recording assemblies with 4 ohm magnetic cutters and crystal play back arms.
Model 12445—78 RPM. Net.....**$24.50**
Model 13700—33 and 78 RPM. Net.....**28.95**
Model 13810—Automatic changer with cutter, 78 RPM. Net.....**40.10**

Write for latest bargain flyer of radios, parts kits, tubes and war surplus.

1947 — COMPLETE RADIO KITS



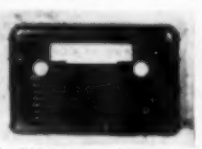
SENSATIONAL PEE WEE AC-DC KIT Model K-PW. Size 6½x5x3½ inches. Very small in size; uses pee wee tubes 1R5, 1T4, 1S5 and 3S4 and new dry disc rectifier. Conventional superhet circuit with AVC; 2 gang condenser. Receives broadcast 550 to 1700 KC. This set when wired according to our diagram will make a hot little personal radio. This kit is priced complete; just as all our kits are, with tubes, cabinet and speaker; nothing else to buy.....Net **$11.95**



5-TUBE AC RADIO KIT superhet circuit using new permeability tuning unit. Covers broadcast 550 to 1700 KC. Beautiful walnut cabinet 12x7x6 5" A5 PM speaker. Everything complete, includes 6SA7, 6SK7, 6SQ7, 6K6 and 5Y3 and diagram Model K-5A.
Net **$16.95**

KIT K-7A 7 tube AC superhet 550 to 1700 KC. Has push-pull audio stage with tone control and 6½ in. alnico 5 PM speaker. Conventional circuit with AVC. Similar in appearance to model K-5A except has slightly larger cabinet. Everything complete including diagram and tubes 6SA7, 6SK7, 6H6, 6SN7, 2—6G6, 5Y3. A real value.....Net **$19.95**

OUR LEADER KIT $9.95, 2 gang cond. AC-DC 4 tube TRF kit 550 to 1600 KC Kit K-4R, a TRF job with a walnut cabinet and 5" alnico 5 PM speaker. All parts furnished; including tubes and diagram. Has direct drive dial and a very simple standard circuit. An ideal kit for the student or experimenter. Just a few hundred to sell .....Very Special at only **$9.95**



NEW PLASTIC CABINET AC-DC SUPERHET KIT. Cabinet size 7x6½x10½". Attractive slide rule dial. Positive drive permeability tuner. Receives broadcast 550 to 1650 KC. Has latest Alnico 5 PM speaker; Loop antenna; all parts, simplified diagram and tubes 12SA7, 12SK7, 12SQ7, 50L6 and 35Z5 furnished. .....Kit P-48 Net **$12.95**

4 TUBE 1½-90 VOLT FARM RADIO KIT. Offered in same cabinet as the above Kit Model P-48. The same high gain broadcast superhet circuit. Complete with 4 tubes; 1R5, 1T4, 1S5, 3S4 and diagram. Less battery pack. Kit model PB-48. Your Cost **$10.95**

DELUXE AC-DC KIT J-D5 Beautiful walnut cabinet and all the parts to build a broadcast 5 tube AC-DC radio. Superhet with slide rule dial, 2 gang tuning condenser and loop aerial. Everything furnished; includes speaker and tubes 12SA7, 12SK7, 12SQ7, 35Z5 and 50L6 and diagram. Kit J-D5.
Net **$14.95**

SHURE GLIDER CARTRIDGE. SPECIAL...**$1.79**
LATEST ASTATIC CARTRIDGE...... **1.79**

TWO-TUBE PHONO OSCILLATOR, $3.69

Complete, wired and tested. 800 to 1500 KC. Model B-4. Has audio gain stage for proper power output. Complete with tubes ready to operate, **$3.69.**
Mike Oscillator model C-4 is similar to model B-4 except has added gain stage for crystal mike. Complete with 3 tubes and fader control **$4.95.** Crystal mike **$4.90** extra.

ASTATIC CRYSTAL PICK-UP WITH NEW NYLON NJI. Cartridge and replaceable Sapphire needle. Very Special **$5.95**

FLUORESCENT BED LAMP. 110 Volt AC. All Plastic construction. Complete with 8 watt lamp. Offered in walnut or Ivory. Dealers.....Net **$5.40**
Power supply to convert 1½-90 volt or 2-90 volt farm and portable radio to 110 volt AC operation. Easily wired to set. Completely wired and tested; with tube and instructions. J-P2. Dealers.....Net **$5.95**
2 Gang condenser, oscillator coil and loop; all matched. Special **$1.95**
2 Gang condenser, ⅜" shaft, cut back section. Special **$1.49**
456 K.C. First and Second high gain I. F. Trans. Special .....Each **.49**
3 or 4 wire 456 oscillator coils..... **.24**
Small loop antennas..... **.39**

McGEE RADIO COMPANY •

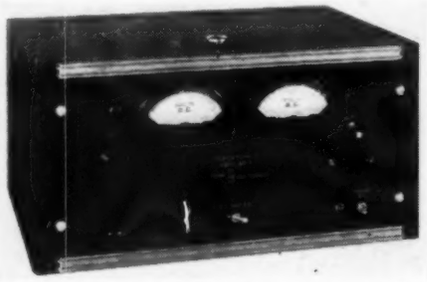
Send 20% Deposit — Bal. Sent C.O.D.
1225 McGEE ST., KANSAS CITY, MISSOURI

What's New in Radio

POWER SUPPLIES

Two new models of their line of electronically regulated power supplies have been introduced by *Furst Electronics* of Chicago.

Models 310-A and 310-B have been specifically designed for production and laboratory tests of a.c.-d.c. receivers, sound amplifiers and similar electronic equipment, universal motors and appliances powered by such motors, and other equipment designed to operate from d.c. power lines.



Output voltage is continuously adjustable over a range which exceeds the variations of line voltages usually encountered. The adjustment may be made by means of a control knob on the front panel. The adjusted output voltage will remain constant regardless of load variations or voltage variations in the a.c. power line, according to the manufacturer.

Full details on either or both of these units will be supplied upon request to *Furst Electronics*, 800 W. North Avenue, Chicago 22, Illinois.

PORTABLE PHONOGRAPH

Lewyt Corporation of Brooklyn, New York has recently introduced several new models of radios, phonographs and radio-phonograph combinations.

One of the unique presentations in this line is the "Hat Box" phonograph, Model 215. This portable unit is housed in a well-constructed carrying case covered with high luster plastic patent similar in appearance to patent leather and trimmed in russet, saddle stitched leather. The interior of the case is lined in red morocco grain. A three tube amplifier, a 5" Alnico V magnetic speaker and a featherweight "glider" crystal pickup, equipped with a permanent, genuine sapphire needle provides faithful reproduction of recorded music. The phonograph operates on 105-125 volts, a.c.

Information about this model and others in the company's line will be forwarded to those requesting it from *Lewyt Corporation*, 60 Broadway, Brooklyn 11, New York.

COMBINATION UNITS

Dearborn Industries of Chicago is currently offering two automatic radio-phonograph combinations for distribution to radio dealers.

Both of the units, the Model 500W console and the Model 100W table model, are available in either Swedish modern wheat finish or a rich walnut finish.

The 500W includes storage space for record albums, a six tube superheterodyne receiver and automatic record changer. The unit stands 35" high, is 19" deep and 21" wide.

The 100W table model combination has a five tube superheterodyne receiver and an automatic record changer which will handle ten and twelve inch records. This unit is 18" x 14" x 14".

Prices and delivery data on these and other combination radio-phonographs in the company's line will be sent to dealers upon application to *Dearborn Industries*, 122 W. Hubbard Street, Chicago 10, Illinois.

FM-AM TUNER

A new FM-AM tuner which provides high-fidelity reception in the high frequency FM band as well as the standard broadcast band has been announced by *Browning Laboratories, Inc.* of Winchester, Massachusetts.

Incorporating a number of modern features, this unit has separate r.f. and i.f. systems for both bands and the entire r.f. section for the FM band uses miniature tubes for highest efficiency.

The tuning range on the FM band extends from 87 to 109 mc. and on the broadcast band from 530 to 1650 kc. The Armstrong circuit is employed in the FM section with two cascade limiters to ensure maximum noise rejection. Bandwidths of i.f. amplifiers are such that high fidelity audio output is realized, according to the manufacturer. Provision is made for using the

E. H. Rietzke, President of CREI, Invites You to Write for this

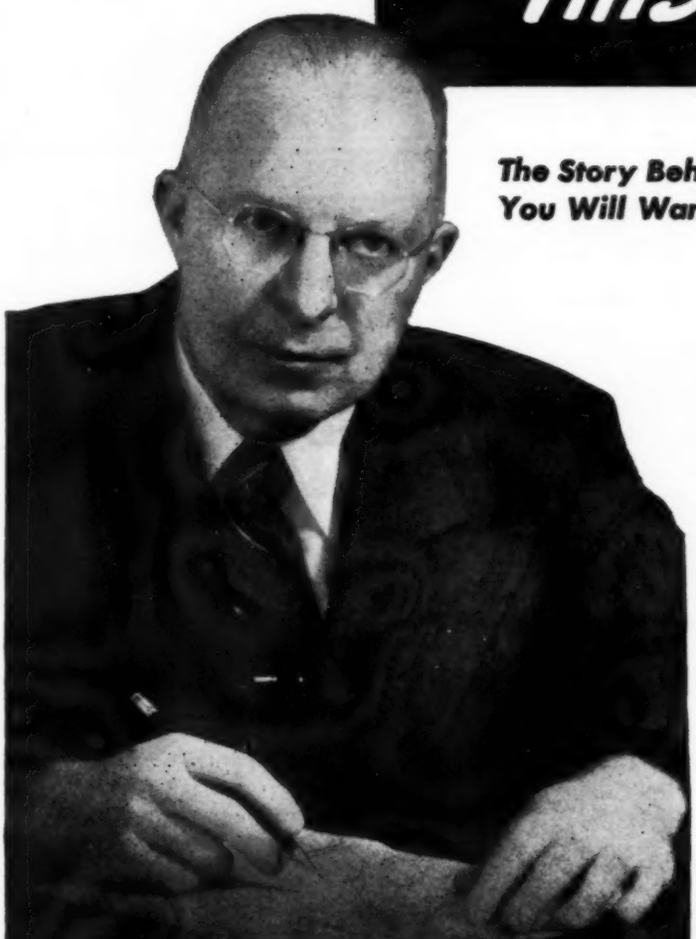
Free Significant Analysis of Job Opportunities in Radio-Electronics

EVERY RADIOMAN

Who Wants to *Hold* His Job

or *Advance* to a *Better* Job

WILL WANT TO READ THIS LETTER!



CAPITOL RADIO
ENGINEERING INSTITUTE
16th and Park Rd., N. W., Washington 10, D. C.

The Story Behind This Interesting Letter You Will Want to Read . . . **Our advertising agents, realizing that vital changes are taking place in the radio industry, asked me to give them a factual report of the unprecedented job opportunities created by the almost unbelievable expansion of the radio industry.**

My letter to them contains some pertinent viewpoints on the subjects of COMPETITION—INDUSTRY EXPANSION—OPPORTUNITIES. These are first-hand observations based on my own experiences . . . a great deal of time spent in the field and constant contact with leaders in the radio industry.

The immediate reaction of our agency upon reading this letter was that it contained so much inspiration and information that it should be reproduced for thousands of radiomen to read. Therefore, this unusual advertisement to invite you to send for, and read, this letter.

It is doubtful if many radiomen realize the actual things that are happening. That is why I think *you* will want to read this letter. You are invited to send for your personal copy today.

E. H. Rietzke
President, CREI

MAIL COUPON FOR FREE COPY • NO OBLIGATION

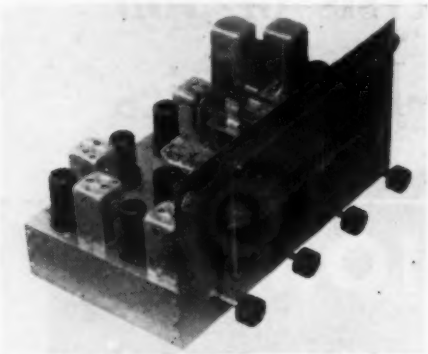
Capitol Radio Engineering Institute
16th and Park Road, N. W., Dept. RN-3
Washington 10, D. C.

Gentlemen: Please send me FREE, Mr. E. H. Rietzke's Analysis of Job Opportunities in Radio-Electronics.

NAME.....
POSITION..... AGE.....
ADDRESS.....
CITY..... ZONE..... STATE.....

new 300 ohm twin lead cables for antenna systems. The same antenna is used for both FM and AM obviating the necessity for separate lead-ins.

The tuner, exclusive of power supply, is 7⅜" x 13½" x 9". The power



supply is a small separate unit designed to be mounted in cramped quarters.

When the same unit is provided for professional installations, the tuner comes in leatherette with rack panel mounting. Space has been provided in this unit for the power supply.

Browning Laboratories, Inc., Winchester, Massachusetts will furnish additional data upon request.

CEMENT AND SOLVENTS

JFD Manufacturing Company of Brooklyn, New York are now offering their line of radio cements, solvents and carbon tetrachloride in four new sized packages which have been redesigned for the convenience of the user.

All of the items in the line are now available in 4, 8, 16 ounce and 1 gallon sizes. The radio cement line comes with brush affixed directly to the metal cap.

Additional details on these newly packaged items will be furnished by *JFD Manufacturing Company*, 4117 Fort Hamilton Parkway, Brooklyn 19, New York.

PORTABLE BRIDGE

Especially designed to facilitate production testing and radio servicing, *General Electric Company's* Electronics Department has recently announced the availability of a new portable condenser-resistor bridge, Type YCW-1 which is capable of measuring a wide range of capacity, resistance and other electrical characteristics of condensers.

The instrument which features push-button switching will also measure the turns ratio of transformers.

The YCW-1 will measure capacity from .000005 to 200 μfd. in three convenient ranges and resistance from 5 ohms to 20 megohms in two ranges. Using the Wien bridge principle with standards of plus or minus one for capacitance and plus or minus two percent for resistance, bridge balance is indicated by a sensitive visual indicator tube. Measurements are obtained by varying a potentiometer with a knob and a pointer until a maximum shadow angle is obtained on the indicator tube; capacitance and resistance values are also indicated by the pointer.

Further information and specifications sheets on this new instrument will be furnished by the Specialty Division, *General Electric Company's* Electronics Department, Wolf Street Plant, Syracuse, New York.

ACOUSTICEL MICROPHONE

Of interest to amateurs and servicemen handling recording and p.a. work is the new BA-105 "Acousticel" microphone recently added to *The*

Brush Development Company's line of crystal mikes.

The new unit provides essentially flat response from 40 to 6000 c.p.s. with high output. The output level is

(*Continued on page* 157)

ESSE Specials!

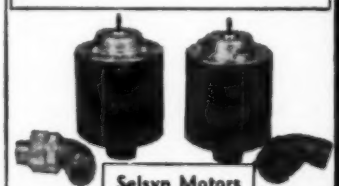
Brand New Meters

2" 0-100 Ma. DC McClintock Co. $3.45
2" 0-150 V. DC Gruen 3.45
3" 0-10 Ma. DC Westinghouse 4.50
3" 0-500 Ma. DC Westinghouse 4.50

Electromode Hot Air Heater

This is a heater used to heat the trucks of the SCR-299 mobile units — which proved highly successful during the war. Operates from 110 V. AC or DC—1,500 watts. Contains blower unit for forced air heating which can also be used for fan during warm weather. Thermostatically controlled with motor protect Thermotron.

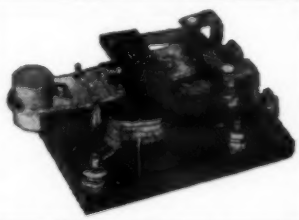
Price $29.50



Selsyn Motors

Use inpairs for direction indicators of beams, wind, etc. Operate from 10-15 V., 60 cycle AC.

Price, each $1.75
Includes plug.



Leach Relay — 24 V. DC

Res. 160 ohms. Poles 3 and 4 make when magnetized. 5 and 6 when unmagnetized.

Price, brand new, each $1.95

Relay – SPDT Type

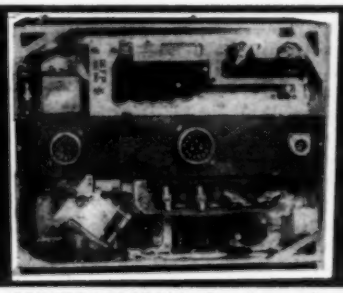
6 ma. 5000 ohm DC resistance.

Price $0.85

PE-103 Dynamotor Unit

Brand new. Used to power your field or mobile transmitter. Designed for use with the BC-654 transmitter and receiver. Input—6 V. DC. 21 amps.; 12 V. DC. 1 1amps. Output—500 V. DC. 160 Ma. Filtered output. Hi-Current relay switches, and overload protect switches self contained in unit. Shipped in original overseas moisture-proof container. Wt of unit 53 lbs.

Price, brand new, each ..... $ 9.95



SCR-522 100-156 Mc. Receiver and Transmitter

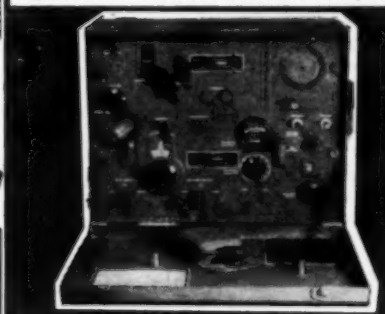
One of the most interesting and useful pieces of surplus equipment. Designed for plane and ground station use, this unit offers remote control of any four pre-selected crystal controlled frequencies in the spectrum of 100-156 Mc. This spectrum covers facsimile, aia navigation aids, airport control, railroad, police, urban telephone, as well as the amateur band 144-148 Mc. October Radio News gives details for converting the SCR-522 receiver section, BC-624.

Transmitter section, BC-625, is voice amplitude modulated and has an output of 8-9 watts.

Tubes used and included: 2—832, 3—12A6, 1—6G6, 2—6SJ7, 1—12J5GT, 3—12SG7, 1—12C8, 1—9002, 3—9003, 1—12AH7GT.

Used, with tubes, less dynamotor and remote control.

Price $29.75



BC-654-A Receiver and Transmitter

Truly the best buy of Army surplus. Frequency range 3800 to 5800 KC.—calibration every 10 KC.—with crystal oscillated check every 200 KC.—power output 17 watts, voice or CW. Shipped as received from Signal Corps Repair Laboratories. Some in new condition with spare tubes, others lacking some tubes. Weight, 45 lbs.

Price $17.95

PE-104 Vibrator Power Supply for operation of BC-654-A receiver from 6 V. or 12 V. storage battery.

Price, new $4.95

AN/ART-13 Collins Autotune Transmitter

A modern, compact, lightweight, high-powered transmitter. For frequency range 2-18.1 Mc. on any of its 11 auto tune crystal controlled or master oscillator channels. December Radio News gives conversion details for converting 24 V. DC operation to 117 V. AC. These units removed from planes. Checked and guaranteed. Weight, 67 lbs.

Price $134.50

(COMPLETE WITH DYNAMOTOR UNIT)

Ohmite

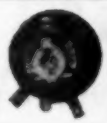
150-watt Model L Potentiometer, 7.5 and 500 ohms.

Price, brand new, each $1.95

Ohmite

Model J — 50-watt Potentiometer, 6 ohm.

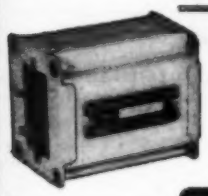
Price $1.25



Ohmite

Model H — 25-watt Potentiometer, 350 ohm.

Price $0.85



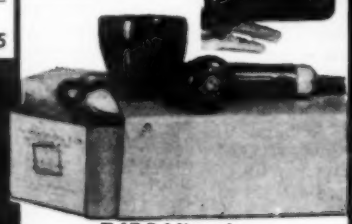
Filter Choke

20 Henry, 50 Ma., 200 ohms DC.

Price **75¢**

Triplett Model 650-SC-AC Voltmeter and Output Meter —Scale 1.5, 6, 15, 60 and 150 V. 4000 ohms res.

Price, brand new, with test leads **$13.50**



T-17-B Microphone

Brand new $1.35

A single button, carbon mike, hard to beat—and at the price. When ordering without additional merchandise, enclose 25c additional for postage and handling.

Same as above but used, either bakelite or aluminum model. Each ..... **95¢**

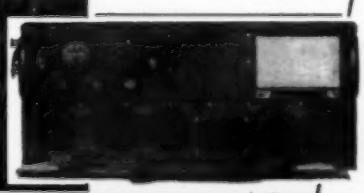
Headphones

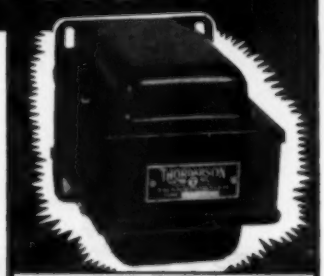
Signal Corps 4,000 ohm magnetic and headband.

Price $1.87

Headphone Extension Cords for Signal Corps phones. PL-55 plug on one end, JK-26 on other. 60" length—used.

Price $0.75





Thordarson T-21X21, Plate and Filament — Secondary 389-0-389 at 200 Ma. 5 V. 3 amp., and 6.3 V. 5 amp. 110 V. 60 cycle pri. A real replacement transformer for large sets.

Price, brand new $3.75

Thordarson—1060 V. CT secondary 300 VA. Pri.—200, 220, 240 V. 60 cycle AC.

Price, brand new $6.50

Thordarson—110 V. 60 cycle pri. sec. 440 V. CT 150 Ma. and 5 V. 3 amp.

Price, brand new $2.25

Filament Transformer

5 V. CT. 7.5 amp. 110 V. 60 cycle pri.

Price, brand new **$1.50**

Ceramic Stand Off Insulator

Use for stand off or mount two base to base for feed-thru insulator. Size 1 1/2" high, base diameter 2 1/8". You can't afford to be without them at the price.

Sold in dozen lots only

Price, each $0.05

TERMS:
CASH with ORDER or 25%
BALANCE C.O.D.
All Items Shipped Collect

ESSE Radio Company

130 W. New York St. · Indianapolis 4, Ind.

EXTERNAL S-METER FOR HALLICRAFTER S20R AND S40 RECEIVERS

By GUY DEXTER

A LARGE number of *Hallicrafters* S20R Sky Champion receivers are in use at amateur stations. A very useful accessory for this receiver is an external S-meter. The Sky Champion has a 5-pin socket in the rear for plugging-in an external S-meter; but since the war, few of these meters have been obtainable. In view of the shortage, no ham would object to building his own S-meter if the circuit and calibration data were offered to him.

Fig. 1 gives the circuit diagram of an external S-meter that works excellently with the S20R receiver. Table 1 gives the calibration data. In all ordinary cases, the reader may mark off his own meter scale according to the data given in Table 1, no further calibration being necessary. The only parts required to build this useful instrument are a 0-1 d. c. milliammeter, five 1-watt carbon resistors, a 10,000-ohm wirewound potentiometer, and a standard 5-pin plug. The entire instrument may be built into one of the small sloping-front meter boxes. If an illuminated meter is employed, the 6.3-volt dial light may be connected through the cable leads to pins 1 and 5 of the plug. This circuit may be used also with the new *Hallicrafters* S40 receiver which apparently has superseded the S20R Sky Champion.

Potentiometer R_2 is used to set the meter initially to zero. Resister R_3 is a shunt used to multiply the meter range to 0-2 milliamperes. If a milliammeter having an internal resistance of some value other than 100 ohms is employed, a different value must be used for R_3. Shunt resistor R_3 always must equal the internal resistance of the milliammeter. It is best to select and adjust the value of R_3 for any individual meter very carefully in a test circuit (until a standard 1-milliampere d. c. input deflects the meter half-scale) before wiring the meter and R_3 into the S-meter circuit.

The author's calibration points were obtained in this manner: After connecting the S-meter to the receiver, a laboratory standard signal generator was connected to the input terminals of the receiver, and both generator and receiver were set to 3 megacycles (a convenient lower-frequency test point). The weakest readable input signal was found to be 2½ microvolts. This deflected the milliammeter to its first scale division (0.02 ma.) and this point was designated S-1. The test signals corresponding to the other S points then were predetermined according to 6 db. spacing (2 to 1 microvolt ratios) between each two successive points from S-1 to S-9, and 5 db. spacings (1.78 to 1 microvolt ratios) between each two successive points above S-9. The signal gen rator output then was set successively to these levels and the meter deflections recorded. If the reader has access to a microvolt-calibrated signal generator, he may repeat the calibration process with his own receiver. It is advisable to use a test frequency lower than 4 megacycles and one on which no radio stations are apt to be picked up during the tests. However, as pointed out earlier in this article, the meter scale may in all ordinary cases be marked off simply according to the data given in Table 1.

SIGNAL STRENGTH	MILLIAMMETER DEFLECTION
50 db. above S-9	0.87
45 " " "	0.85
40 " " "	0.83
35 " " "	0.80
30 " " "	0.78
25 " " "	0.76
20 " " "	0.73
15 " " "	0.70
10 " " "	0.66
5 " " "	0.64
S-9	0.54
S-8	0.48
S-7	0.41
S-6	0.34
S-5	0.28
S-4	0.20
S-3	0.14
S-2	0.06
S-1	0.02

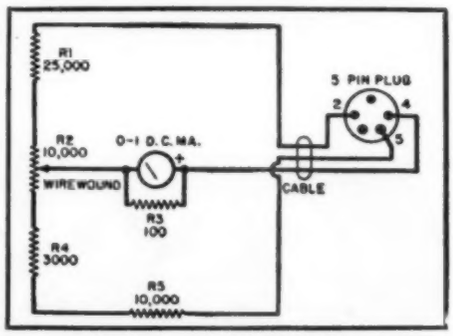
Table 1. Dial calibration of S-meter.

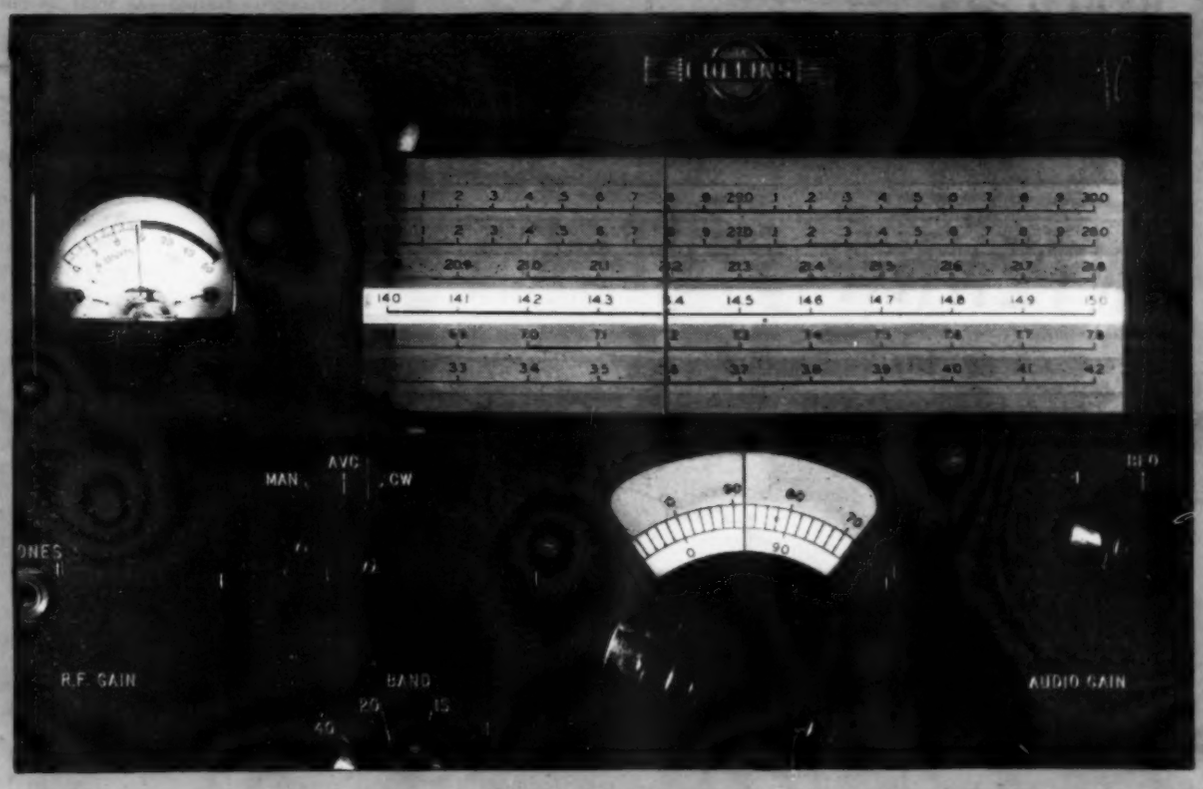
The meter is simple to use: (1) Insert S-meter plug in meter socket in rear of receiver. (2) Switch-on receiver, throwing receiver standby switch to "*RECEIVE.*" (3) Switch-on a. v. c. (4) Switch b. f. o. off. (5) To turn on S-meter, advance receiver r. f. gain control all the way to the right until switch on this control clicks. (6) Temporarily ground receiver antenna terminals to prevent signal pickup, and set meter to zero by adjusting potentiometer R_2 in S-meter circuit. *At frequent intervals during normal use of receiver, S-meter zero should be inspected, always grounding antenna terminals temporarily or detuning receiver dial to prevent signal pickup, and R_2 should be adjusted to return meter pointer to zero.* (7) After setting meter to zero, tune in signal and read its intensity on meter scale.

Whenever the S-meter is used, a. v. c. must be switched on and b. f. o. off, and the r. f. gain control must be advanced all the way to the right until the S-meter switch on this control is heard to click on. The positions of the audio gain control, noise limiter switch, and tone control do not affect indications of the S-meter.

This S-meter does not give flattering indications of signal strength, neither is it especially "scotch" in perform-

Fig. 1. Circuit diagram of S-meter. All resistors are 1 watt and the internal resistance of meter movement is 100 ohms.





The Collins Band-Lighted Dial Gives You *Added Pleasure*

Wherever the Collins 75A receiver is shown—hamfests, fairs, club meetings—the band-lighted dial wins enthusiastic endorsement from all who can crowd close enough to see it. And no wonder! It's so easy to use, both visually and mechanically, that once you've used it you'll see why it ranks high among the many new features of this receiver.

Here's how it works. The dial amply covers six amateur bands—80, 40, 20, 15, 11 and 10 meters. When you turn on the filament supply, the dial lights are turned on. ***But only the band selected for use is lighted!*** There's no band pointer to get out of adjustment, no feeling for the detent action, ***and no scanning the dial to see where the frequency indicator is!*** With only one band lighted at a time you just naturally read the correct figures at first glance.

The vernier dial, which gives you directly the exact frequency to within 1 kc (2 kc on 11 and 10 meters), works the same way. Only the band you're listening to is lighted. The frequency shown in the photograph is 14,394 kc.

The band-lighted dial is further proof of Collins interest in amateurs. In every equipment designed and built for amateurs by Collins, you'll find engineering that advances the art of amateur radio.

FOR RESULTS IN AMATEUR RADIO, IT'S . . .

COLLINS

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA

11 W. 42nd St., New York 18, N. Y. **458 S. Spring St., Los Angeles 13, Calif.**

ance. Several hundred tests made by the author in the laboratory and on received signals both in the broadcast and amateur bands (as well as comparison with S-meter response in a number of competitive receivers) indicate that the calibration data given in Table 1 is fair in every respect.

An individual builder who cannot afford to tie up his one and only 0-1 milliammeter in an S-meter can mount all of the parts in a small box and provide a small jack for plugging-in the meter when needed for this purpose.

—30—

60-Watt Transmitter

(*Continued from page* 43)

ically on all sides and no difficulty is experienced from stray feedback. Since the oscillator tank circuit is quite close to C_{12} such feedback could present a problem.

The value of meter shunts for the various stages will depend upon the size meter used. Any meter having a full scale reading between 1 ma. and 10 ma. may be used. The meter shown in Fig. 1 is one purchased from Army surplus and happened to read 7 ma. full scale. Since the meter scale was calibrated from 0 to 3, the shunts were wound to make the full-scale milliampere reading a multiple of the scale reading; i.e., 9, 60, 150, and 300 ma. The shunts are wound of 1-ohm per foot resistance wire and the actual value determined by connecting the meter and shunt in a calibrating circuit. The calibrating circuit consists of a variable resistor, 1½-volt battery, and a calibrated meter which covers the ranges desired.

Operation

Tune up of the transmitter is done in the conventional manner. While tuning the oscillator and buffer-multiplier stages and neutralizing the final, switch S_5 should be kept in the *"Tune"* position. Switch S_4 should be in the *"Send"* position.

With no crystal in the circuit, the oscillator cathode current will be approximately 6 ma. With crystal in the circuit and oscillating, the oscillator cathode current will be approximately 18 ma. The current during non-oscillating periods is limited by cathode resistor R_1. The best method of tuning the oscillator is to tune for maximum grid current on the final. The oscillator can be roughly tuned by adjusting for maximum plate current on the buffer-multiplier stage, and later the tuning can be touched up to give maximum drive to the final.

The cathode current of the buffer-multiplier with no excitation will be approximately 8 ma. With excitation the cathode current will rise to about 20 ma. The best method to use for adjusting the buffer-multiplier stage to resonance is to tune for maximum grid current on the final stage.

When using the 6AG7 as a buffer, 10 to 15 ma. grid current can be obtained on the 815. When operating under this condition it will be neces-

TOP TRANSMITTER PARTS VALUES

RELAYS

A DPST N.CL.Leach 1355. 115v/60c coil. 10a contacts, coin silver..... **$1.59**

C. SPDT contacts; coil rated 115v/60..... **$1.39**

D. SPST Latching relay made by Kurman. Make coil 115v/60c; DCR 1500 ohms. Break coil 115vdc 10 ma; DCR 5000 ohms..... **2.95**

E. DPST Telephone type; 2p, 1 cl; 1 open cont. rating 5a at 50v, coil rating 3.5 ma (at 12K ohms), 1000 vac..... **1.05**

F. DPDT Steatite insulated 10 amp silvered contacts, made by Leach..... **1.95**

G. SPDT Struthers-Dunn sensitive keying relay, 5 MA-DC Coil. 110v/60 cycles—2 Amp contacts..... **1.49**

Cardwell Split-Stator type PK-200-QD. 200-30 mmf per section. Special Hi-Volt with 2" spacing. **$9.95**
Johnson type 500D35, 500-35 mmf. .08" spacing. (Listed at $11.75).. **$4.75**

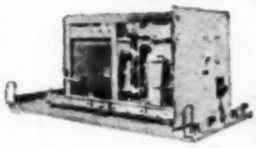
Instruction books for the BC-191, same as 375 SCR-528, SCR-508, SCR-538, and the ZA-1 equipments. Each..... **50c**

BC-610 TUNING UNITS $4.95. We have just received a limited supply of Tuning Units for the BC-610. They are all in NEW or very good condition. When ordering specify frequency range.

Ohmite Wire-Wound Rheostat

Model H	250 Ohms	25 Watt...	**$0.98**
Model H	125 Ohms	25 Watt...	**.98**
Model J	1800 Ohms	50 Watt...	**1.25**
Model K	3000 Ohms	100 Watt...	**1.98**
Model L	250 Ohms	150 Watt...	**2.25**
Model N	22 Ohms	300 Watt...	**3.00**
Model P	1200 Ohms	225 Watt...	**2.75**

RA-58-A HI-VOLTAGE POWER SUPPLY



Ideal for breakdown insulation testing, or as a source of power for a pulse transmitter. This unit supplies continuously variable voltages between 500 and 15,000 volts DC at 35 ma. A voltage Doubler circuit using two 705a rectifiers and two 1 mf condensers is employed. RMS ripple voltage at maximum power is 6%. THIS UNIT OPERATES FROM 115 v/60c. Variable voltage is obtained by means of a Variac in the primary circuit of the high voltage transformer. Size is 21"x17½"x29" deep. Net weight 314 lbs. This unit sells for the low price of **$116**

SONAR SOUND DETECTION UNIT

Ideal for detecting underwater sounds, such as fish swimming in schools, within a 15 mile area. Using a Rochelle salt crystal, which is about 1000 times more sensitive than quartz, as the active unit the sound is transmitted up a 60 ft. length of cable. It is completely enclosed in a solid rubber sheath. This sound detector was originally used in harbor defense. Coupled to an audio amplifier, this can be found to have many valuable applications. Ask for SD-1.... **$9.95**

NEW POWER SUPPLY for LM-18 freq. meter. Output: 290 v @ 20 ma; 13 v @ 600 ma. Input: 105-125 v @ 60 cps; 260 ma; 27.6 W. type 84 rectifier tube; shock mounted. Complete with input and output plugs, tube included..... **$14.75**

HI-VOLT OIL CONDENSERS

.15-.15mf 6000vdc GE pyranol 26F435.... **$4.50**
.1-.1 mf 7000vdc GE pyranol 26F435.... **1.50**
In lots of 50..... **1.00**
.15-.15 mf 8000vdc Sprague Vitamin Q. **5.25**
G.E. Pyranol 23F47 2mf 4000v. List $30. **5.25**
G.E. Pyranol 23F49 2mf 5000v. List $27..... **4.75**
C-D TC-50010 1mf 5000v. List $30. **4.50**
G.E. 14F191 .1mf 10000v. List $37. **6.75**
G.E. Pyranol .06 mf 15,000 vdc. List $25..... **5.00**
G.E. 14F136 Pyranol .75mf 20KV **22.00**

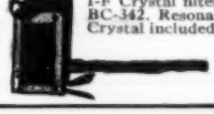
New USN Navy Model RAK-7 Ship Receiver
$69.95

15 kc to 600 kc. 6-tube receiver with: AVC-Band pass filter-Audio filter—Noise limiter—Precision tuning with a Vernier dial—Voltage regulated power supply, with three tubes, for 60 cycle, 115 volts. Can be battery operated. Complete with spare parts box weighing 73 lbs., tubes and instruction book.

SPECIAL ITEMS

Visors for 5 inch 'scopes..... **$0.75**
Tube shields for 2AP1..... **.98**
Broadcast band push-button tuning units inductive or capacitive types. **$1.49**
Hand generator, type GN-45B. Output: 6v-3a/300v-.14a rated speed 60 cps..... **$5.95**
Mushroom rubber earphone cushions for lightweight set—2 pair for..... **$0.89**
Oscilloscope chassis, completely punched, for use with a 2 inch tube. Octal sockets included 15"x11"x9"..... **$1.50**
Sonde UHF transmitter, complete, less battery..... **$3.75**
Microphone element T-30-K for throat mike selling 2 for..... **$0.50**
Microphone unit MC-419 for lip microphone..... **$0.98**
140 mmf split stator variable midget condenser..... **$1.49**
Silver button mica condensers. 175-180-185 mmf..... ea. **$0.05**
Lots of 100..... **4.50**
Silver button mica condensers: 400 and 500 mmf..... ea. **$0.10**
Lots of 100..... **9.50**
Feed-through glass insulator 7½" long, Beehive external section..... **$1.10**
Black crackle finished cabinet for relay rack mounting 19" W x 25" H x 15" D with hinged door in back.... **$6.00**

XTAL FILTER



I-F Crystal filter for BC-312. BC-342. Resonant at 470 kc. Crystal included.

$6.95

MICROWAVE PARTS AND EQUIPMENT

Magnetrons!! Type 2J32 (JAN.) just released. The 2J32 is designed for 10 cm. operation. Rated at 300 kw peak pulse power. Complete information supplied. Brand new, packed in individual protective cartons. The 2J32 is listed at $200.
OUR PRICE.. **$25.50**

3J31's just received. One cm. magnetron listed at $95.00. OUR PRICE..... **$20.00**

KLYSTRON oscillator tubes 2K25/723ab, designed for 3 cm. operation. New. With complete data. Listed at $38.00..... **7.75**

Duplexer using 1B24 3 cm..... **10.00**

30 mc oscillator-amplifier with 2 6AC7's. Uses 723ab, Waveguide input, xtal detector. With 6AC7's..... **10.00**
With 6AC7's and 723ab..... **16.50**

Thermistor Beads (D-170396), for use with UHF and Micro-Wave Equipment (List $3.00). In separate sealed containers.... **.95**

Magnets for Magnetrons, ea..... **12.00**

3 CM WAVE GUIDE SECTIONS

Silver Plated Directional Couplers with a 20 DB drop with:

A. Wave guide 90° bend 15" long..... **$ 4.00**
B. 15° bend in wave guide 15"..... **4.40**
C. 30° bend in wave guide 10" long..... **3.95**
D. 90° bend in wave guide 15" long also 90° bend in coupler..... **5.50**

SECTIONS

E. T Section with choke terminations.... **$5.00**
F. 2½ foot silver plated with 90° bend (2" radius)..... **4.50**
G. 150° bend with 90° twist 3½" radius with pressurizing nipple and coax coupler..... **3.95**
H. 2½ foot 3 cm wave guides choke to cover fitting..... **4.95**
J. 5 foot 3 cm wave guide section per foot..... **1.95**
K. Slotted dipole antenna 3cm..... **4.00**

HI-VOLTAGE TRANSFORMERS

3200 volts. AC 150 M.A. 115 volt. primary, 60 cycles. Designed for half wave operation with 150 M.A. output each, two transformers hooked up with secondaries in series and primaries in parallel will give 3,000 volts, output at 300 M.A. from a full wave rectifier. These are conservative, continuous commercial ratings..... **$7.25**
Jefferson Power Transformers 115 v 60cy/660 vct-85 mc/6.3v-7.3A/5v-2A/6.3v—.3A..... **$3.50**
Power supply transformer. Made by Subsig. Pri. 115/60 cps Sec. 1:750vct-.113a; Sec. 2:6.3vct-5a; Sec. 3:5v-3a. 2500TV specially priced at..... **$5.95**

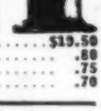
CHOKES

2 hy @ 160 ma. Made by GR..... 2 for **$1.00**
12 hy-12 hy @ 150 ma., 15 amp. rating, each price..... **3.35**
12 hy @ 165 ma 200 ohms DCR made by Thordarson. Price..... **2.00**
59 hy @ 100 ma 850 ohms DCR made by Jefferson. Price..... **2.00**
2.6 hy @ 800 ma stud and terminals at bottom made by G.E..... **5.95**

AUDIO TRANSFORMERS, MODULATORS, ETC.

Modulation xfmr: typical for 211's cl. A50W..... **$1.35**
Modulation xfmr: 807 to pr 807's..... **1.00**
Modulation xfmr: pr. 811's to 813..... **5.00**
Audio output transformer Split pri. 1500 OHMS each side. Secondary impedance 85 ohms center-tapped —6:1 ratio. 100 watts output..... **5.50**
Line to Voice coil transformer. Pri 600 ohms. Sec 6 ohms. 1200 Test volt..... **1.45**
INPUT: Single Button to grid 20:1..... **1.00**

MICA CONDENSERS



F3L .0003 mfd 8000v list $29.00..... **$3.75**
Solar type SX .0015 mf 3000v list $9.95.... **.75**
Sangamo G-4 .004 mf 20kv list $110.00.. **25.50**
Sangamo G-3 .006 mf 10kv list $87.50..... **$19.50**
.0008 mf 5000vdc C-D No. 599-6H..... **.80**
.0002 mf 5000vdc Aerovox..... **.75**
.0004 mf 3000vdc Faradon..... **.70**

All merchandise guaranteed. Mail orders promptly filled. All prices F.O.B. New York City. Send Money Order or Check. Shipping charges sent C.O.D.

COMMUNICATIONS EQUIPMENT CO.

131-A Liberty St.
New York City 7, N. Y.
Telephone WH 4-7658

OIL FILLED CONDENSERS

1 mf 300 vdc	**$0.25**	1 mf 1000 vdc	**$0.85**
2 mf 300 vdc	**.30**	2 mf 1000 vdc	**.98**
4 mf 300 vdc	**.35**	1 mf 1500 vdc	**1.05**
4 mf 400 vdc	**.55**	.4 mf 1500 vdc	**.30**
5-5 mf 400 vdc	**1.15**	2 mf 600 ac/1000.	**.95**
2 mf 550 vdc	**.30**	4 mf 1500 vdc	**1.30**
.25 mf 600 vdc	**.25**	1 mf 2000 vdc	**1.20**
.85 mf 600 vdc	**.30**	.1 mf 2500 vdc	**1.20**
1 mf 600 vdc	**.35**		
2 mf 600 vdc	**.40**		
3 mf 600 vdc pyr	**.65**		
4 mf 600 vdc pyr	**.70**		
6 mf 600 vdc pyr	**.95**		
8-8 mf 600 vdc	**1.49**		
15 mf 600 vdc	**1.75**		

DRY ELECT. COND.

500 mf 200 vdc... **$1.95**
2000 mf 50 vdc... **2.00**
4000 mf 30 vdc... **2.25**

TUBE SPECIAL

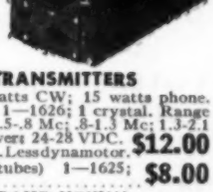
Tube Type	Appro. List	Your Cost	Tube Type	Appro. List	Your Cost
2AP1	$12.00	$3.75	5FP7	$32.00	$4.25
3BP1	15.00	3.95	5JP2	48.00	8.98
3FP7	27.00	2.98	837	2.80	1.35
5BP1	20.00	4.95	872A	7.50	2.45
5BP4	29.00	7.95	705A	22.50	6.75
5CP1	45.00	4.95	241B-WE	85.00	48.00
5CP7	48.00	6.00	861	155.00	85.00
5FP4	35.00	4.95	304PL		8.00

Sockets for 5CP1, 5BP1, 3BP1, 705a, 829.... **$0.95 ea.**

Test Set EE65—Made by Conn. T & E Corp. **$29.50**

This unit is used for checking and maintaining field telephone systems by testing for all types of failures in the lines, such as opens, shorts, grounds, crosses with other lines, capacity between lines, insulation resistance, and many of the other faults possible in a phone system.

NEW ARC-5 SUPERHET RECEIVERS



Tubes (included) 3—12SK7; 1—12K8; 1—12SR7; 1—12A6. Freq. range: 190 kc.-550 kc. Complete with control box, dynamotor, rack, shock mounts, and all the necessary plugs. Tubes and schematic are included.... **$12.00**

(SCR-274-N) TRANSMITTERS

ARC-5 Transmitters; 25 watts CW; 15 watts phone. Tubes: 2—1625; 1—1629; 1—1626; 1 crystal. Range (specify frequency desired); .5-.8 Mc; .8-1.3 Mc; 1.3-2.1 Mc; 4-5.3 Mc; 5.3-7 Mc; Power: 24-28 VDC. Remote control. Rack&plugs. Less dynamotor. **$12.00**
Modulator unit; (with tubes) 1—1625; 1—VR150; 1—12J5..... **$8.00**

These units are BRAND NEW!!!
LIMITED QUANTITY!!

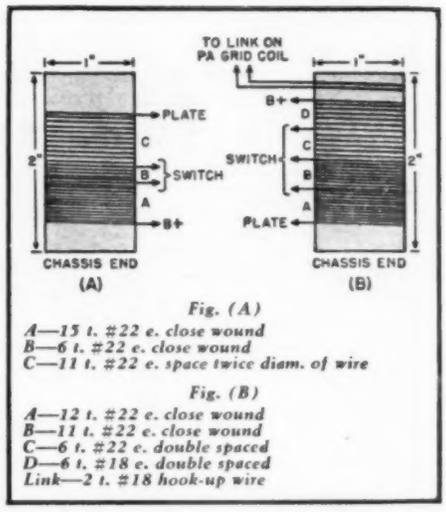


Fig. (A)
A—15 t. #22 e. close wound
B—6 t. #22 e. close wound
C—11 t. #22 e. space twice diam. of wire

Fig. (B)
A—12 t. #22 e. close wound
B—11 t. #22 e. close wound
C—6 t. #22 e. double spaced
D—6 t. #18 e. double spaced
Link—2 t. #18 hook-up wire

Fig. 5. Coil data. (A) Oscillator coil, L_1. (B) Buffer-multiplier coil, L_2.

sary to reduce the grid current to the rated value of 3 to 4 ma. by detuning the grid circuit of the final slightly. Approximately 8 ma. grid current can be obained when doubling in the 6AG7 stage, and approximately 4 ma. when quadrupling.

After the tuning of the 815 grid circuit has been completed, the stage should be neutralized. Neutralization will not be found critical, and a spacing of about ⅜ inch between each neutralizing plate and the tube envelope will be approximately correct. This will, of course, depend upon the individual circuit construction.

For tuning the final plate circuit, set the meter switch to read final plate current, throw switch S_5 to *"Operate"*, and tune the final tank capacitor for minimum plate current. Resonant plate current will be 10 to 15 ma. The final can then be loaded to rated plate current of 150 ma. The final screen-grid current under loaded conditions will be approximately 15 ma.

The plate current of the modulator should be checked before beginning operation, and the bias adjusted so that the no-signal plate current is 20 ma.

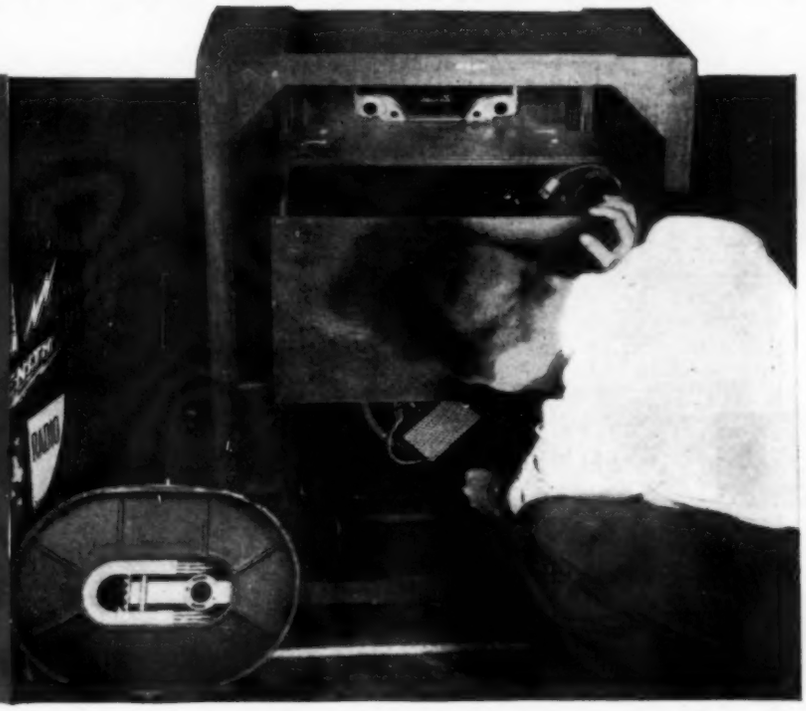
When operating c.w., the key is connected between terminals 3 and 4 of the relay terminal strip on the rear of the transmitter. Switch S_5 is placed in the *"Tune"* position. For phone operation switch S_5 is placed in the *"Operate"* position. Switch S_4 controls the carrier for both c.w. and phone. With c.w. operation, S_4 in the *"Send"* position places the exciter stages in operation and closing the key then puts the final amplifier on the air. With phone operation S_4 puts all stages in operation.

The transmitter has been in use on the 10 meter and 80 meter bands for several months with very pleasing results. Even on 75-meter phone where the QRM is plenty bad this little transmitter has stepped right out. Reports received from England averaged an S7 or better. So it is no joke—you can work out with low power.

—30—

Don't Waste Time Figuring How to Take It Apart

PHOTOFACT* FOLDERS give you complete disassembly instructions



Do you lose valuable time discovering how to take out chassis, speakers and record changers from some of the new combinations? Are you familiar in all cases with *the proper sequence of removal?* Whenever the procedure is complicated, PHOTOFACT FOLDERS give you complete disassembly instructions—enable you to do an efficient job without damaging panels, dials, grilles or any other parts of the set. Better still, you're sure of getting them back together again in the quickest possible time.

That's not all PHOTOFACT FOLDERS do. They make it easy to diagnose trouble, locate defective parts, decide on adequate replacements and *get them in a hurry.* They do this by means of exclusive numbered photographs, full-page easy-to-read schematics, complete parts listings, record changer analyses and many other helps that assist you in making *up to twice as many repairs a day.*

PHOTOFACT FOLDERS are the result of actually examining and testing the instruments covered. They are based on *original research*—not on "canned" or copied information. They cover *all* the latest radios, phonographs, record changers, recorders, communications systems and power amplifiers. Sent to you in sets of 30 to 50 folders, they cost only $1.50 a set. This includes membership in the Howard W. Sams Institute. Actually they cost you nothing for they pay for themselves over and over again in time saved.

Over 25,000 radio service engineers use and depend on them! Give servicing worries the go-by! Spend less time, do better work—and more of it—by seeing your distributor or by using the convenient coupon.

*Trade Mark Reg.

PUBLICATION DATES

Set No. 13 . . . February 10
Set No. 14 . . . February 25

Cut this out and MAIL OR TAKE IT TO YOUR DISTRIBUTOR. If you do not know his name and address, send it directly to Howard W. Sams & Co., Inc., 2924 East Washington Street, Indianapolis 6, Indiana, and we will see that your nearest distributor gets it. In Canada, write to A. C. SIMMONDS & SONS, 301 King Street East, Toronto, Ontario. Canadian Price, $1.75.

- ☐ Send Set No. 14 (Feb. 25)
- ☐ Send Set No. 13 (Feb. 10)
- ☐ Send Set No. 12 (Jan. 25)
- ☐ Send Set No. 11 (Jan. 10)
- ☐ Send me Volume 1 (including Sets Nos. 1 to 10) with De Luxe Binder, $18.39. Individual Sets Nos. 1 to 10, $1.50 each.
- ☐ Send me a De Luxe Binder (at $3.39)

My (check) (money order) (cash) for ..... is enclosed. (If you send cash, be sure to use registered mail.)

PLEASE PRINT

Name _____

Address _____

City _____ *Zone* ____ *State* _____

Company Name _____

My Distributor's Name _____

City _____

HOWARD W. SAMS & CO., INC. RADIO PHOTOFACT SERVICE

In Canada—write to A. C. SIMMONDS & SONS, 301 King Street East, Toronto, Ontario

Parts Lists

(FOR CIRCUIT DIAGRAMS APPEARING ON PAGES 72 AND 73)

BELMONT BOULEVARD

Part No.	Code and Description
C-9B9-82	R_3—47,000 ohm, ⅓ w. res.
C-9B3-98	R_4—1 megohm, ⅓ w. res.
C-9B9-106	R_5, R_7—4.7 megohm, ⅓ w. res.
C-9B9-84	R_6—68,000 ohm, ⅓ w. res.
C-9B3-37	R_{12}—10 megohm, ⅓ w. res.
C-9B9-92	R_{13}, R_{14}—330,000 ohm, ⅓ w. res.
A-8J-10295	C_1, C_2—.03 μfd., 150 v. cond.
A-8G-11083	C_3—40 μμfd. cond.
A-8J-10297	C_6, C_7—.01 μfd., 150 v. cond.
A-8J-10298	C_8—50 μμfd., 150 v. cond.
A-8J-10296	C_9—.005 μfd., 150 v. cond.
A-13G-11303	C_{10}, C_{11}—1.2 μμfd., ±.2 μμfd. (two wires)

CROSLEY MODELS 56XTA, 56XTW

Part No.	Code and Description
AW-134994	4—Ant. coil
AW-134993	5A, 5B—Osc. coil (two sections)
AW-137495	6—First i.f. trans.
AW-134158	7—Second i.f. trans.
B-135163	9A, 9B, 9C—Variable cond.
AB-135088	10—Trimmer cond.
GC-210685-143	11—580 μμfd. mica cond.
39004-3	12—50 μμfd., mica cond.
39001-80	13, 19, 20, 21, 22—.02 μfd., 600 v. cond.
39001-19	14—.1 μfd., 600 v. cond.
39001-17	15—.05 μfd., 600 v. cond.
39004-9	16—220 μμfd. mica cond.
39001-76	17—.003 μfd., 600 v. cond.
B-137649	18A, 18B—50/30 μfd., 150/150 v. elec. cond.
	23—Trimmer (part of item #10)
39294-11	24—470 ohm, ½ w. res.
39294-17	25—4700 ohm, ½ w. res.
39294-28	26—330,000 ohm, ½ w. res.
39294-38	27—15 megohm, ½ w. res.
39294-27	28—22,000 ohm, ½ w. res.
39294-27	29—220,000 ohm, ½ w. res.
39294-34	30—3.3 megohm, ½ w. res.
39294-23	31—47,000 ohm, ½ w. res.
39294-35	32—4.7 megohm, ½ w. res.
39294-29	33, 34—470,000 ohm, ½ w. res.
39294-8	35, 42—150 ohm, ½ w. res.
AD-137664	36—Speaker and trans. assembly
W-135808	37A, 37B, 37C—Band change sw. assembly
C-46846-6	38A, 38B—1 megohm vol. control and sw.
	39—Trimmer cond. (part of item #3)
39015-26	40—1200 ohm, 1 w. res.
39015-9	41—47 ohm, 1 w. res.

MAJESTIC MODELS 7C432, 7C447

Part No.	Code and Description
9-184	R_1—22,000 ohm, ½ w. res.
9-208	R_2—220 ohm, ½ w. res.
9-320	R_3—22,000 ohm, 1 w. res.
9-206	R_4—3.3 megohm, ½ w. res.
9-201	R_5—47,000 ohm, ½ w. res.
13-19	R_6—.5 megohm vol. control
9-160	R_7—10 megohm, ½ w. res.
9-211	R_8—470,000 ohm, ½ w. res.
14-6	R_9—2 megohm tone control (on sw.)
9-207	R_{10}—470,000 ohm, ½ w. res.
02-83	R_{11}—820 ohm, ½ w. res.
9-169	R_{12}—1000 ohm, 1 w. res.
9-269	R_{13}—18,000 ohm, ¼ w. res.
5-40	C_1—.05 μfd., 200 v. cond.
6-159	C_2, C_{18}—47 μμfd., 500 v. cond.
	C_3, C_4—Trimmers (part of tuning unit)
5-77	C_5—.05 μfd., 600 v. cond.
	C_6, C_7—Trimmers (part of T_1)
5-39	C_8—.1 μfd., 200 v. cond.
	C_9, C_{10}—Trimmers (part of T_2)
6-151	C_{11}, C_{14}—220 μμfd., 500 v. cond.
19-26	C_{12A}, C_{12B}, C_{12C}—30/10/20 μfd., 400/400/25 v. elec. cond.
6-112	C_{13}—.01 μfd., 200 v. cond.
6-132	C_{15}, C_{16}—.01 μfd., 400 v. cond.
5-61	C_{17}—.005 μfd., 600 v. cond.
5-37	C_{19}—.01 μfd., 200 v. cond.
3-159	T_1—First i.f. trans.
3-160	T_2—Second i.f. trans.
12-27, or 12-26	T_3—Output trans.
2-16	T_4—Power trans.

GRANTLINE MODELS 500, 501

Part No.	Code and Description
C-9B1-78	R_1—22,000 ohm, ½ w. res.
C-9B1-26	R_2, R_8—150,000 ohm, ½ w. res.
C-9B2-63	R_3—1200 ohm, 1 w. res.
C-9B1-34	R_4—3.3 megohm, ½ w. res.
101196	R_5, S_1—500,000 ohm vol. control and sw.
C-9B1-35	R_6—4.7 megohm, ½ w. res.
C-9B1-42	R_7—22 ohm, ½ w. res.
C-9B1-29	R_9—470,000 ohm, ½ w. res.
C-9B1-52	R_{10}—150 ohm, ½ w. res.
C-9B2-44	R_{11}—33 ohm, 1 w. res.
C-8F3-6	C_1—47 μμfd. mica cond.
124100	C_2, C_6—Ant. and osc. trimmers
108157C	C_3, C_4, T_5—Input i.f. coil assembly
C-8F3-11	C_5—330 μμfd. mica cond.
C-8D-10953	C_7—.15 μfd., 400 v. cond.
C-8D-10770	C_8, C_9—.05 μfd., 200 v. cond.
119-92	C_{10}, C_{11}—20/40 μfd., 150/150 v. elec. cond.
108157C	C_{12}, C_{13}, T_4—Output i.f. coil assembly
C-8F3-10	C_{14}—220 μμfd. mica cond.
C-8D-10761	C_{15}, C_{19}—.01 μfd., 400 v. cond.
C-8D-10813	C_{16}—.05 μfd., 400 v. cond.
C-8F6-121	C_{17}—470 μμfd. mica cond.
C-8D-10788	C_{18}—.004 μfd., 600 v. cond.
111136B	T_1—Antenna coil assembly
110126	T_2—Osc. coil assembly
B-18A-11124	T_3—4" PM dynamic speaker and trans.

ZENITH MODELS 4K016, 4K035

Part No.	Code and Description
63-654	R_1—180,000 ohm, ¼ w. res.
63-594	R_2—68,000 ohm, ¼ w. res.
63-669	R_3—3.9 megohm, ¼ w. res.
63-1235 or 63-1351	R_4—Vol. control
63-587	R_5—4700 ohm, ¼ w. res.
63-976	R_6—15 megohm, ¼ w. res.
63-271	R_7—1 megohm, ¼ w. res.
63-600	R_8—2.2 megohm, ¼ w. res.
63-634	R_9—820 ohm, ¼ w. res.
63-583	R_{10}—1000 ohm, ¼ w. res.
22-1453 or 22-1454	C_1—Two-gang var. cond.
22-829	C_2—.05 μfd., 200 v. cond.
22-162	C_3—.0001 μfd., 600 v. cond.
22-196	C_4—.01 μfd., 600 v. cond.
22-448	C_5—.004 μfd., 600 v. cond.
22-684	C_7—8 μfd., 150 v. elec. cond.
	C_8—First i.f. trans., pri. (on T_1)
	C_9—First i.f. trans., sec. (on T_1)
	C_{10}—Second i.f. trans., pri. (on T_2)
	C_{11}—Second i.f. trans., sec. (on T_2)
	C_{12}—Broadcast osc. (on C_1)
	C_{13}—Broadcast ant. (on C_1)
S12024	L_1—Antenna coil
S12014	L_2—Osc. coil assembly
95-814	T_1—First i.f. trans.
95-839	T_2—Second i.f. trans.

AIR KING MODEL 4608A

Part No.	Code and Description
	R_1—22 ohm, ½ w. res.
	R_2—22,000 ohm, 2 w. res.
	R_4—2200 ohm, ½ w. res.
	R_5—Vol. control & sw.
	R_6—10 megohm, ¼ w. res.
	R_7—270,000 ohm, ½ w. res.
	R_8—470,000 ohm, ¼ w. res.
	R_9—150 ohm, 1 w. res.
	R_{10}—2.2 megohm, ¼ w. res.
	C_1—.005 μfd., 400 v. cond.
	C_2, C_4, C_5, C_9—.05 μfd., 400 v. cond.
	C_3—47 μμfd., 500 v. cond.
	C_6, C_7, C_{15}—40/40/25 μfd., 150/150/25 v. elec. cond.
	C_8—220 μμfd., 500 v. cond.
	C_{10}—.002 μfd., 400 v. cond.
	C_{11}—470 μμfd., 500 v. cond.
	C_{12}—.01 μfd., 400 v. cond.
	L_1—Loop aerial
	L_2—Osc. coil
	L_3—First i.f. trans.
	L_4—Second i.f. trans.

NOISELESS RECEIVER CHECKING

SERVICEMEN may welcome this suggestion for cutting down the noise usually present in the service shop when several receivers are undergoing intermittent checks or routine operating tests.

In order to eliminate noise, unsolder the speaker voice coil leads and put a little pilot light socket across the transformer. Screw a small Christmas tree light bulb or a 6-volt pilot bulb in and let it wink.

Connect the signal generator in the usual manner. Turn up the volume so the lights are fairly bright, then any variation in the output will be easily discernible . . . . . H.H.

SOON . . . THE NEW

NATIONAL NC-173

The NC-173 is the wholly new product of months of post-war research, prompted by war-time advances in radio technique.

The new "Double Diode" noise limiter and the new AVC system are effective on both phone and CW. The voltage-regulated oscillator circuits are extremely stable. The frequency range includes the 6-meter amateur band. (0.54 to 31 and 48 to 56 MC.)

The NC-173 offers all the features you expect in a fine receiver. A glance at the illustration below will suggest the versatility of its adjustments and the handiness of its controls, but only a trial will prove its thoroughbred qualities. Study the advanced design of its 13-tube circuit, appraise its modern styling and challenge its performance with the toughest conditions that crowded amateur bands can offer.

Here is a receiver a man can be proud to own. See it at your dealer's within the next 30 days.

Est. NC 1914

NATIONAL

COMPANY, INCORPORATED

Malden, Mass.

THE MOST DISTINCTIVE NAME IN RADIO COMMUNICATIONS

Sound Recording

(*Continued from page 54*)

the studio. This is important if proper *balance* between the lower and higher frequencies is to be maintained.

When a sound is reproduced at a higher level than that of the original, the low bass frequencies will appear to be *accentuated*. If the sound is reproduced at a lower level than the original, bass frequencies will appear to be *attenuated* (suppressed) with respect to other portions of the frequency spectrum.

Noise

Noise is usually considered to be *random* sound waves with little or no periodicity. That does not completely define noise for certain "noises" are associated with certain commonplace events; for instance, the creaking of doors or gates, the clicking sound made by walking on a hard surface with leather heels, etc. The hum of an electric motor is considered noise, yet an analysis of the sound by means of an oscillogram would indicate a definite periodicity. Again it seems that the distinction between the classification of sounds is psychological in origin and relative to the observer.

The Technical Aspects of Sound

Sound is usually characterized as wave motion of which there may be three forms, namely, harmonic, periodic, and random.

Waves are propagated disturbances and may be *transverse* or *longitudinal*, depending upon the direction of the disturbance.

In a *transverse* wave, the particles of the medium vibrate in a direction perpendicular to the direction of propagation. For example, in a water wave, the individual particles of water move up and down, while the direction of wave motion is along the surface, or perpendicular to the particle motion. Thus, a water wave is a transverse wave.

A *longitudinal* wave is so named because the particles of the medium vibrate in a direction parallel to the direction of propagation. In a sound wave, for example, the individual particles of air move back and forth in the same direction that the wave is traveling. Thus, a sound wave is a longitudinal wave.

A *wavefront* may be classified as *plane* or *spherical*. Since a wave in general spreads out uniformly in all directions from its source or origin, the wavefront will be spherical close to the source. However, at some distance from the source the curvature is practically zero, and the wave is considered to be a plane wave. If a pebble is dropped in a still pond, circular waves will spread out in all directions, but by the time they have traveled a considerable distance, the waves will be essentially straight. Thus, a wave which starts out spherical (or circular in two dimensions) eventually becomes essentially a plane wave.

Harmonic Motion is a wave pattern of the sine or cosine curve type as in Fig. 4A. All harmonic motion can be described by an equation of the form: $y = A \sin \omega t$

where: y = displacement of the disturbance, A = maximum displacement (which occurs at 90° and 270°), ω = circular frequency (to be defined in detail) in degrees per second, t = time after disturbance is initiated.

Periodic Motion is a wave pattern compounded from two or more harmonic motions of different frequencies as in Fig. 4B. Periodic motions are analyzed by determining the various harmonic components. The character of any periodic motion is controlled by the number and magnitude of its various harmonic components.

Random Motion is a conglomeration of harmonic motions exhibiting little or no periodicity. Speech, squeaks, scraping, etc., all produce random motion unless they are sustained for long periods. The number of harmonic components is so great and their duration is so irregular as to make the harmonic analysis of random motion a practical impossibility. A typical wave pattern of random motion is shown in Fig. 4C.

Harmonic and periodic motions have certain defining characteristics which must be considered. These are:

Cycle, which is a sequence of events or motions that recur in exactly the same order in certain time intervals. For example, the motion of a pendulum started from one side, allowed to swing to the opposite and back to the starting side, comprises one complete cycle. This is illustrated in Fig. 4D.

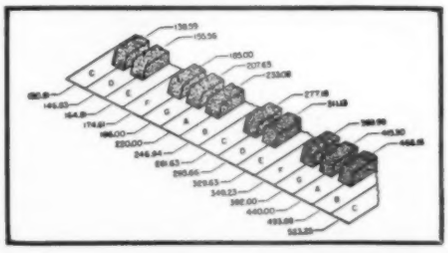
Period is the time required for the motion to complete one set of recurring values, or one cycle. It is usually defined by the symbol T.

Frequency is the rate at which the cycles recur and is usually presented in one of two ways. If the frequency is given as ω, it is known as the circular frequency and has the dimensions, radians per second. The frequency may also be given as cycles per second or the symbol f in which case it is connected to the circular frequency by the relation: $f = \omega/2\pi$

Wavelength is the distance between two corresponding points on harmonic or periodic waves (Fig. 4A) and is denoted by the symbol λ.

Fundamental Frequency is the low-

Fig. 6. Diagram illustrates section of a piano keyboard and shows tempered scale for one octave on each side of middle C.



RHS TELEVISION—SCOPE—POWER EQUIP'T

BUILD YOUR OWN HIGH-SPEED PHOTO FLASH

As described in Dec., 1946, issue of Radio News (page 52). COMPLETE with Diagram, Parts, Wire, and Flash Tube (Amglo 51Q4X). SPECIAL..... **$49.95**

OSCILLOSCOPE KIT

5CPI Cathode ray tube	ea.	$6.95
Socket for 5CPI	"	1.98
Anode button for 5CPI	"	.35
2X2A Rectifier tube	"	1.25
Plate cap for 2X2A ceramic	"	.25
Socket for 2X2A ceramic	"	.20
Xformer, 1600v at 4ma., 700v ct at 150ma., 6.3v at 8A. 115v 60 cyc.	"	8.50
Condenser, oil .5-2000v	"	2.10

ORDER SEPARATE OR COMPLETE KIT.....Special **$16.95**

OIL CONDENSERS

1 mfd.	600v	$0.35	1	mfd. 2000v	$0.95
2 mfd.	600v	.60	2	mfd. 2000v	2.10
4 mfd.	600v	.75	3	mfd. 2000v	2.95
8 mfd.	600v	1.10	4	mfd. 2000v	3.95
10 mfd.	600v	1.40	10	mfd. 2000v	6.95
1 mfd.	1000v	.90	.05	mfd. 3000v	1.95
2 mfd.	1000v	1.05	.25	mfd. 3000v	2.95
4 mfd.	1000v	1.10	1	mfd. 3000v	3.50
8 mfd.	1000v	2.00	1	mfd. 5000v	6.85
10 mfd.	1000v	2.40	2	mfd. 4000v	7.60
15 mfd.	1000v	2.60	.1	mfd. 7000v	3.95
25 mfd.	1000v	5.95	1	mfd. 9000v	14.95
24 mfd.	1500v	6.95	.0056	mfd. 9000v	14.95

ANTENNA REFLECTORS
for Collinear & Corner Reflector Antennas

Get more DX—Directionalize your antenna. 31"x60" rigid screen reflector and ¾ tubing frame..... **$4.95**

Order two for Corner Reflector antenna.

WESTON SENSITROL RELAYS

110V—A.C. Reset—Model 705
0-500 Microamps.
0-50 Microamps.
2-0-2 Microamps.

SPECIAL—YOUR CHOICE..... **$12.95**

RELAYS

Sigma #4RJ 2000 ohms SPDT. Can adjust to less than 1ma..... **$1.98**

HIGH CAPACITY CONDENSERS

2400 mfd.—50WVDC	$1.95
4000 mfd.—18WVDC	1.95
4000 mfd.—30WVDC	2.95
1000 mfd.—15WVDC	.99

TUBES (Brand New) ARMY-NAVY INSPECTED

1E7G	$1.25	836	$2.95
2AP1	4.95	837	3.75
2C40	3.95	829A	3.99
2D21	1.50	838	3.95
2V3G	1.75	841	1.75
211	6.95	861	89.95
3AP1	5.95	866	.99
3BP1	6.95	872A	2.75
311	6.95	814	7.95
5BP1	6.95	884	1.50
5BP4	6.95	885	1.50
6AB7	1.25	8003	9.95
6AC7	.95	8005	4.95
6AG5	1.10	8016	1.95
6AG7	1.25	8025A	4.95
6AJ5	1.98	9JP1	14.95
6AK5	1.60	954	.99
6AL5	.99	955	.99
6AR6	1.29	956	.99
6AS6	1.29	957	.99
6AS7	1.29	9001	1.19
6C4	.75	9002	.99
6C5	.90	9003	.99
6F6	.99	9004	.99
6J4	2.25	9005	1.10
6J5	.90	9006	1.15
6J6	.99	15E	4.95
6L6	1.59	1619	.99
6Q4	1.25	1625	.89
6SL7	.99	1626	.89
6SN7	.99	250TH	14.95
6V6	1.19	2050	1.50
6SH7	.89	2051	1.50
7A4	1.45	257B/8001	
801	2.30		14.95
802	1.15	28D7	1.95
803	9.95	30	.89
804	8.95	35T	3.50
805	5.50	304TH	16.95
807	1.05	726A/C	7.50
809	2.25	100TH	7.95
810	3.55	1N21	.49
811	2.95	1N23	.49
813	7.95	2C26A	.99
815	3.95	3E29	3.75
VR90/30	.99	CK1006	1.98
VR105/30	.99	HF200	14.95
VR150/30	.99	HK24G	1.49

VT 127A. 3.00

3½ KILOWATT TUBE (New)

JAN-128A (Federal).
SPECIAL $75.00

MODULATION XFORMER
Government Rating

40 watt audio (Westinghouse). Separate plate and screen windings. Z ratio 3:1—can use push-pull 803's, 100TH's 813's, HK254's.
SPECIAL..... **$24.95**

POWER SUPPLY FOR MARK 1-11-111 BC-19 OR OTHER EQUIPMENT

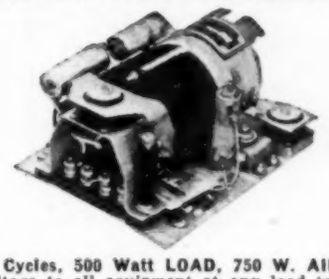
12 Amp-12v D.C. from 110v A.C. Unnecessary to tear set apart. Leave set portable.
COMPLETE READY TO PLUG IN..... **$32.50**

SELENIUM RECTIFIERS
Full Wave Bridge Types

Input	Output		
18v ac	12v dc	5-Amp	$4.95
18v ac	12v dc	10-Amp	7.95
18v ac	12v dc	15-Amp	10.95
18v ac	12v dc	30-Amp	16.95
36v ac	28v dc	5-Amp	7.95
36v ac	28v dc	10-Amp	13.95
36v ac	28v dc	15-Amp	19.95

Federal's New Midget Selenium 1.60
Immediate Delivery

CARBON PILE REGULATOR



115V, 60 Cycles, 500 Watt LOAD, 750 W. AIR BLAST
Uniform voltage to all equipment at any load to 500 watts. Regulates voltages to test bench and sets under test. Line voltage regulator for output of gas driven generators. Regulates line voltage from outlets in the average home. Used in rural areas where line voltage surges.
Excellent Buy at..... $14.95

TRANSFORMERS—115v ac 60 cyc
HI-Voltage Insulation

6500v at 4 ma.	$ 9.95
6000v at 2 ma.	7.95
3950v at 4 ma. tap at 1250v-1 ma.	7.50
3710v at 10 ma.; 2.5v at 3A; 2.5v at 3A.	9.95
2500v at 10 ma.	6.50
2100v at 10 ma.	6.50
4000v at 2 ma.	6.50
442-0-442v at 1000 ma.	9.95
2.5v at 10 amps.	3.25
6.3v at 6.6 amps.	3.25
6.3v at 21.5 am.; 2.5 at 2 amp.; 6.3 at 2 amp.	6.95
2.5v at 3 amp.	3.95
5v at 115 amp.	14.95
5v at 190 amp.	17.50

FILTER CHOKES—HI-VOLTAGE INSULATION

12 Hy.—100 ma.	$2.35	12 Hy.—300 ma.	$3.95
4 Hy.—250 ma.	3.95	15 Hy.— 30 ma.	1.95
10 Hy.—150 ma.	3.95	20 Hy.— 90 ma.	2.25
4 Hy.—600 ma.	5.95	75 Hy.— 8 ma.	1.95

JOHNSON TUNING CONDENSERS

200FD20	$3.95
250F20	2.39
250E30	2.39

PORTABLE FM XMITTER

Freq. range 72-82 MC. Easily Doubled to 2 Meters. Complete Brand New with diagram, 5 tubes, microphone, and collapsible antenna.
Special—(less batteries) **$17.50**

VIBRATOR POWER SUPPLY
VOLTAGE REGULATED

6v or 12v dc Input. Delivers: 1.5vdc at 700ma; 1.5vdc at 700 ma; 7.5vdc at 300 ma; 90vdc at 45ma; 90vdc at 25 ma; 150vdc at 45ma.
COMPLETE with VR90/30; CK1005; & Vibrator..... **$14.95**

MICA CONDENSERS, SANGAMO

.001-20,000v	$9.95	.004-8000v	$2.25
.0005-20,000v	9.95	.002-8000v	2.25
.0005-8000v	2.25	.006-6000v	1.95
.00025-8000v	2.25	.007-5000v	1.75
.005-8000v	2.25	.003-8000v	2.25

NATIONAL DRIVE UNIT ONLY

PW-O or NPW-O **$2.95**

All material is new and guaranteed, unless otherwise specified.
No mail orders for less than $2.50—20% deposit required with all orders.

RADIO HAM SHACK Inc.

63 DEY STREET • NEW YORK 7, N. Y.

est component frequency of a periodic wave motion.

Harmonic Frequency or overtone, when applied to music, is that component of a periodic wave motion whose frequency is an integral multiple of the fundamental frequency.

Sub-Harmonic Frequency is that component of a periodic wave whose frequency is an integral submultiple of the fundamental frequency.

An *Octave* is the interval between two waves whose frequencies are in the ratio of 1:2.

Each of these above four terms is illustrated in Fig. 4E.

Behavior of Sound Waves

From a purely physical concept, sound can be considered as an alteration in pressure, displacement of particles, or the velocity of particles in elastic media. These pressure or velocity changes are produced by a *transducer,* which is an electro-mechanical or electro-acoustic system for converting electrical vibrations into mechanical or acoustical vibrations respectively. Microphones and loudspeakers are typical transducers as is the sounding diaphragm of Fig. 2. The motivating source for the diaphragm can be mechanical (as shown) or electrical as in the case of a loudspeaker. Since sound is a particular type of wave motion, it becomes desirable to consider particular behavior of waves.

1. If two harmonic waves pass through the same point while vibrating at the same frequency, the resultant wave formed by adding the displacements will also be a harmonic wave.

2. Conversely, any harmonic wave can be resolved into a number of component harmonic waves. This principle is covered by *Fourier's Theorem.*

3. If two harmonic waves start at the same point and experience similar displacements at the same time, they are said to be *in phase* with each other. However, if one wave lags or leads the other, then they are said to be *out of phase* (Fig. 3B). It is customary to denote phase difference in angular units as that part of 360 degrees or 2 π radian.

Almost everyone has witnessed some example of wave interference. For instance, in Fig. 3A, the component waves (both are identical and appear as one) form a harmonic wave at twice the original amplitude. This is said to be *constructive interference.* In Fig. 3B the component waves are of the same frequency and amplitude but 180 degrees out of phase, and therefore, cancel each other in what is called *destructive interference.* The resulting wave caused by the superposition of two waves of almost, but not quite the same frequency as in Fig. 3C has the characteristic of *beats,* i.e. alternate periods of constructive and destructive interference. Beat phenomena are particularly important in their application to superheterodyne reception.

When two identical waves travel with the same speed but in opposite

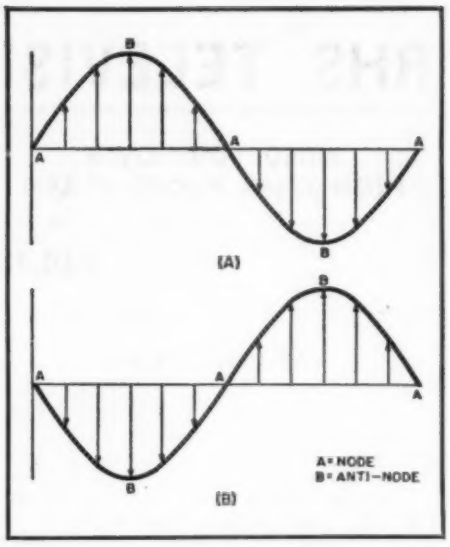


Fig. 7. Illustrates displacement of waves.

directions, the resulting wave is known as a stationary or *standing wave.* While there is no translational motion, the vibratory displacements persist. The displacements are of equal magnitudes for distances one-half wavelength apart and the wave takes the form shown in Fig. 7A at some particular time and then reverses as shown in Fig. 7B. As can be seen from the figure, certain portions of the wave experience little or no displacement. The points of maximum displacement are called *anti-nodal points* or *loops* and the points of zero displacement are called *nodal points.* Standing waves are of great importance in the theory of antenna design.

The Speed of Sound

The speed of sound in any medium is a function of the density and elastic qualities of the medium.

The variation of the speed of sound with temperature is expressed by the formula:

$$v_t = v_o \sqrt{1 + \frac{1}{273}\, t}$$

where:

v_t = velocity at temperature t
v_o = standard velocity at 0° C
t = temperature in degrees C

The speed of sound in air at one atmosphere pressure at 0° C is approximately 1088 ft/sec. while at 100 atmospheres the speed of sound is 1150 ft/sec.

Pitch and Intensity

The pitch of a sound is best characterized by its frequency, except for certain psychological effects. The audible range is known to be between 16 and 20,000 cycles per second, but the average ear does not hear below 30 cycles per second nor above 16,000 cycles. However the pitch, as received by the human ear, is not a direct function of the frequency and varies with the intensity. This effect has been investigated in considerable detail by Fletcher.[1]

[1] Fletcher, H., "Speech and Hearing," D. Van Nostrand, New York, 1929.

NEW . . . Simpson Model 305RC Tube-Tester with "No Backlash"* Roll Chart

With the addition of the new Simpson "No Backlash"* Roll Chart to the 1947 version of our Model 305, this famous instrument becomes beyond question the finest tube-tester on the market in its price range. Read the description of this new Roll Chart in the panel below.

Model 305RC provides for filament voltages from .5 volts to and including 120 volts. It tests loctalc, single ended tubes, bantams, midgets, miniatures, ballast tubes, gaseous rectifiers, acorn tubes, Christmas tree bulbs, and all popular radio receiver tubes.

Like other Simpson tube-testers, the Model 305RC incorporates 3-way switching which makes it possible to test any tube regardless of its base connections or the internal connections of its elements. This method, the result of exhaustive research and expensive construction, protects the Model 305RC against obsolesence to a degree not enjoyed by competitive testers. No adapters or special sockets are required. In addition to having a complete set of sockets for every tube now on the market, this tester has a spare socket, to provide for future tube developments.

The Model 305RC has provision for testing pilot lamps of various voltages as well as Christmas tree bulbs. It tests gaseous rectifiers of the OZ4 type—also tests ballast tubes direct in socket for burnouts and opens. Has neon bulb of proper sensitivity for checking shorts. This tube-tester is fused, and has the latest improved circuit. It provides for line adjustment from 100 to 130 volts, with smooth vernier control.

Model 305RC is distinguished for its beautiful exterior. It has a two-tone metal panel in red and black on a satin-finished background. Sockets and controls are symmetrically arranged for quick operation. The large, modern, fan-shaped instrument has an exceptionally long scale. It has "good" and "bad" English markings, also a percentage scale for matching and comparing tubes. Cases, both portable† and counter style, are made of strongly built hardwood, durably and beautifully finished.

Size, 11"x11"x6". Wt. 10 lbs. Shipping wt., 15 lbs.
Dealer's net price, portable or counter model.....**$59.50**
For 60 cycle 115 volt current only.
For 220 volt or 60 cycle, add..... **7.50**
Standard Model 305, with book-type speed chart **49.50**

Counter Model 305RC. Same instrument as portable model, but set in fine walnut finished hardwood case, with tilted, easy-to-use panel.

†Finished hardwood cases are standard on portable models. When these are not available, the instrument is housed in attractive simulated-leather covered case.

*6 Exclusive Features Make This the Finest Roll Chart Ever Designed for Tube-Testers . . . . .

- "No Backlash" feature of this Roll Chart automatically takes up all slack in the paper chart and, by keeping it in constant tension, makes it impossible to turn the selector wheel without turning chart. Gives precision selection at all times. Also prevents chart from tearing or getting out of alignment.
- Gearing is such that only 6 turns of selector wheel will run the entire length of the 12½ ft. chart.
- Easy to read. The clear Lucite window is just wide enough to show 2 tube settings, or both settings on a multi-purpose tube.
- Entire unit removable by taking out four screws. Just lift from receptacle to make new entries or install new chart.
- Chart ingeniously fastened to rollers, affording easy replacement and constant alignment.
- Rigid, light-weight construction. Gear driving mechanism incorporates heavy-duty precision brass gears and parts.

Simpson

INSTRUMENTS THAT STAY ACCURATE

SIMPSON ELECTRIC COMPANY
5200-5218 W. Kinzie Street, Chicago 44, Illinois
In Canada, Bach-Simpson, Ltd., London, Ont.

While intensity is popularly considered to be synonymous with loudness, a distinct difference exists between the two. The former is a pure physical quantity while the latter is psychological in origin. In a strict physical sense, intensity is defined as the average rate of flow of energy per unit area in a direction normal to the rate of flow. It is expressed by the formula:

$$I = \frac{1}{2}\frac{(p_{max})^2}{\rho_o c}$$

where p_{max} = the maximum pressure developed above the steady pressure for no disturbance, c = wave velocity, ρ_o = medium density, I = intensity in watts/sq. cm.

The equation may also be written in the form:

$$I = \frac{1}{2}\rho_o c\omega^2 d_{max}$$

where d_{max} = maximum displacement and ω = circular frequency = $2\pi f$.

For acoustic measurements, the choice of the equation depends on whether the recording instruments respond to pressure or displacement variations.

Current practice now employs the decibel as a relative measure of intensity. The bel (so named after Alexander Graham Bell) is defined as follows:

$$b = \log_{10}\frac{I_1}{I_2}$$

where I_1 and I_2 are the absolute intensities.

The bel is a large unit, an intensity ratio of 10 to 1 being equivalent to only 1 bel. This would mean dealing with rather small numbers, so it is customary to use the decibel, which is one tenth of a bel. Thus the numbers with which we deal are 10 times as large when speaking of decibels as they are when speaking of bels. To convert to decibels, the value in bels must be multiplied by 10. Thus:

$$\text{db.} = 10\log_{10}\frac{I_1}{I_2}$$

An intensity ratio of 10 to 1 would thus be equivalent to 10 db., and 3 db. would be equivalent to an intensity ratio of 2 to 1.

On the other hand, the loudness of a tone is a function of its frequency and intensity and can be defined as the magnitude or stimulus it creates in the auditory system. This implies a relative measure of loudness and some reference level must be established for comparison. The tone emitted at 1000 cycles at 0 db. is taken as this level and the loudness of any particular tone is determined by adjusting the reference tone until it sounds as loud as the one being tested. The increase in intensity of the reference tone is interpreted in terms of loudness units. Fletcher and Munson have done much work along this line and their results have been published in the *"Journal of the Acoustical Society of America."* Obviously, a certain amount of human error is bound to be injected into such measurements, however, correlation by statistical methods has yielded some very valuable information.

The db. meter used for measuring sound levels has a scale which is usually calibrated from −10 to +6 db. This type of meter is usually calibrated for use across an impedance load of 500 ohms and is actually a voltmeter of the rectifier type. Many systems do not standardize on 500 ohm lines and there are many occasions when it is desirable to use a standard meter across voice coils of speakers, etc. having different impedances.

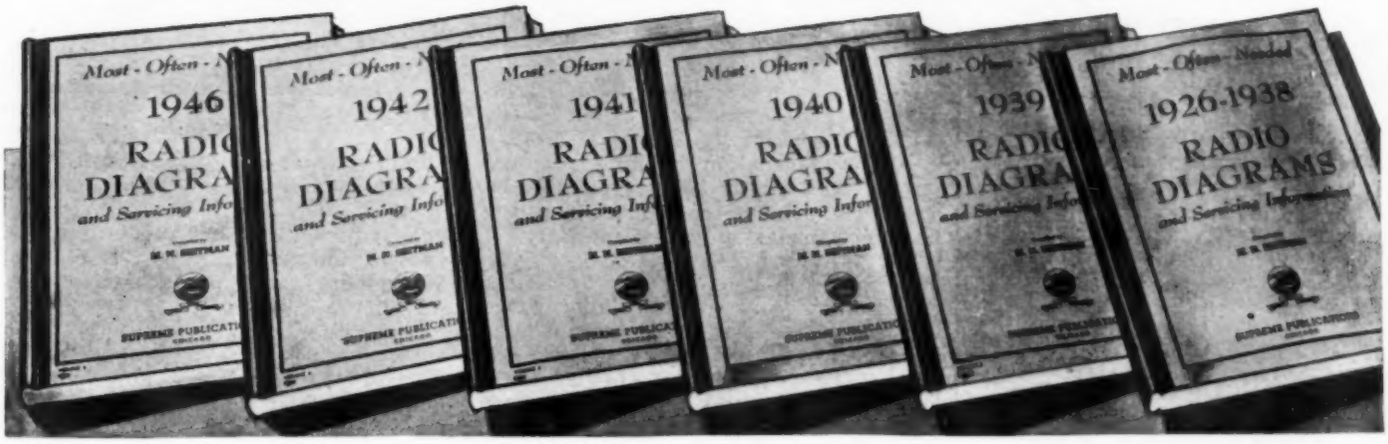
Fig. 5 shows how such meters may be used across loads of from 2 to 4000 ohms. For example, reference to the table in Fig. 5 will show that if a 500 ohm meter is used across a speaker voice coil of 8 ohms, 18 db. must be added to the meter reading.

Multipliers are needed, as with any other voltmeter, if an additional range over +6 db. is desired. For average meters, the resistance required will be approximately 5000 ohms-per-volt.

In the transmission and reproduction of sound, consideration must be given to the human ear as a transducer (here the sound waves are transformed into a stimulus for the auditory system.) The ear exhibits certain non-linear characteristics which affect the fidelity with which sounds are received. For instance,

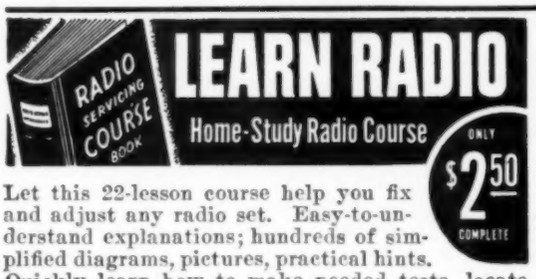
(*Continued on page* 157)

RADIO DIAGRAMS



Covering 1946, 1942, 1941, 1940, 1939,] [1926-1938

Each manual contains between 192 and 240 pages. Price each $2.00 **This volume $2.50**



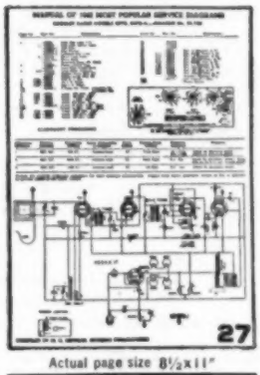
Let this 22-lesson course help you fix and adjust any radio set. Easy-to-understand explanations; hundreds of simplified diagrams, pictures, practical hints. Quickly learn how to make needed tests, locate faults, complete the repair. Includes many lessons for beginners.

MANY ADVANCE LESSONS

Learn new speed-tricks of radio fault finding, case histories of common troubles, servicing short cuts, extra profit ideas. Many large lessons on the use of regular test equipment, explanation of signal tracing, television to the minute, recording dope. With this information you will save enough time on a single radio job to pay the special $2.50 price for the complete course of 22 money-making lessons. Many active servicemen used this reduced price radio training for brush-up and study of new service methods. Reprinted in 1946 with information on signal-tracing, television, visual alignment, P.A., photocells, etc. All about AVC, how to use an oscilloscope, what is feedback, resonance action, and every other fact you must know to be more expert in your work. Large size: 8½x11 inches, 224 pages and index. Order without any risk. Price only..... **$2.50**

Compiled by M. N. Beitman, radio engineer, teacher, author, and serviceman.

You can simplify and speed up all radio repairs with SUPREME PUBLICATIONS manuals. Service radios faster, better, easier, save money and time, use these **most-often-needed** diagram manuals to get ahead in radio servicing. At unbelievable low cost (only $2 for most volumes) you are assured of having in your shop and on the job, needed diagrams and essential repair data on 4 out of 5 sets you will ever service. Every popular radio of every make, from old-timers to new 1946 sets, is included. Clearly printed circuits, parts lists, alignment data, service hints are the facts you need to improve your servicing ability. Save hours each day, every day, let these six volumes furnish diagrams for 80% of all sets. See picture of these attractive manuals above. Each volume has between 192 and 240 pages, large size: 8½ x 11 inches, each with index. Manual style binding. Send coupon today. Satisfaction guaranteed.



Actual page size 8½x11"

Most Popular Models Made by:

R. C. A., Zenith, Philco, Sears, Fada, Emerson, Belmont, Detrola Radio, Majestic, United Motors, G.E., Westinghouse, Arvin, Stewart-Warner, Admiral, Delco, Stromberg - Carlson, Western Auto, Wards, Sparton, Motorola, Gamble, and many others.

FIX ANY RADIO

Amazing New Invention

New, revolutionary different COMPARISON technique permits you to do expert work on all radio sets. Most repairs can be made without test equipment or with only a simple meter. Many point-to-point, cross-reference, circuit suggestions locate faults instantly. Covers every radio set—new and old models. 24 large, trouble-shooting blueprints. Charts for circuit analysis. 114 tests using a 5 cent resistor. Price, only..... **$1.50**

Guarantee

All manuals sent on 10-day trial basis. You must be entirely satisfied or your money will be refunded.

Supreme Publications
(In business 14 years)
CHICAGO 12, ILL.

Supreme Publications

PUBLISHERS OF RADIO BOOKS, MANUALS AND DIAGRAMS

★ ★ **STEWART-WARNER MANUAL** **50c**

★ ★ **ARVIN DIAGRAM MANUAL** **50c**

★ ★ **GENERAL-ELECTRIC MANUAL** **50c**

64 pages of popular circuits. Size: 5½ x 8½ inches

RECORD PLAYERS & RECORDERS MANUAL

Just what you need to repair quickly thousands of automatic record changers, manual players, phono pick-ups, wireless oscillators, recorders, and combinations. Hundreds of mechanical and electrical diagrams. Instructions for adjustment and repair. Most popular units of all makes. 128 large pages, 8½ x 11 in. Price, postpaid, only..... **$1.50**

See Your Radio Jobber or Send Coupon ►

NO RISK TRIAL ORDER COUPON

SUPREME PUBLICATIONS, 9 S. Kedzie Ave., Chicago 12, ILL.
Ship the following manuals: (Satisfaction guaranteed or money back)

- ☐ Radio Servicing Course..... @ $2.50
- ☐ Simplified Radio Servicing... @ 1.50
- ☐ Stewart-Warner Manual .... @ .50
- ☐ Arvin Diagram Manual..... @ .50
- ☐ General-Electric Manual .... @ .50
- ☐ Record Players and Recorders... 1.50

- ☐ 1946
- ☐ 1942
- ☐ 1941
- ☐ 1940
- ☐ 1939

PRICED AT ONLY $2.00 EACH

- ☐ 1926-1938 @ $2.50

☐ I am enclosing $..... send postpaid.

☐ Send C.O.D. I am enclosing $..... deposit.

Name: .....

Address: .....

International Short-Wave
(*Continued from page* 57)

until the desired transmitting frequency is obtained. These currents are applied to a large watercooled transmitting valve (tube) type TA 12/20000 K having an input of 25-27 kilowatts at a plate voltage of 8000-12000 volts.

"The generation of high powered short waves only became possible by the use of watercooled transmitting valves (tubes), a Philips specialty."

The Results

For an account of PCJ's appearance on the air, we quote from a front-page story in *"The Wireless World and Radio Review,"* London, of April 27, 1927:

"For the second time in the short history of broadcasting it has been left to Holland to steal a march on this country and, in fact, on Europe, generally. It will be remembered that some long while before broadcasting here was introduced, British amateurs were accustomed to listen to the broadcasting station at The Hague which, with the call-sign PCGG, sent out regular Sunday afternoon concerts, mainly for the benefit of listeners here. Now again Holland sets the example by leading the way to short-wave broadcasting. On the 15th of March the station PCJ, established at the Philips Lamp Laboratories at Eindhoven, in Holland, communicated by wireless telephony with the Dutch station at Bandoeng, in the Dutch East Indies. The transmission was carried out on a wavelength of approximately 30 meters.

"Since that initial success fairly regular broadcasting has been conducted. Now, as we go to press, comes the announcement that the Sydney station, 2BL, has successfully rebroadcast one of the programs. We congratulate Holland, and the Philips Company in particular, on the enterprise shown in establishing this broadcasting record, more especially so as the purpose is apparently to provide a means for long-distance broadcasting, and advantage has been taken of the peculiar suitability of the 30-meter wavelength.

"It will be of interest to observe whether this example set by Holland will be followed by other countries in Europe."

Eddie Startz tells me that "the very first transmissions of PCJ during March 1927 became a huge success, as next morning a telegram was delivered in Eindhoven stating that the transmission was received with incredible strength, steadiness and purity by a radio-amateur at Bandoeng (Java, Dutch East Indies). Subsequent transmissions proved that this result was not due to sheer luck, but that a really reliable communication was established. The stream of reports began to flow to the transmitter at Eindhoven. Reports were received from all parts of the world.

"During 1927, several relays of the Daventry (England) station, destined for the British Dominions, were successfully carried out.

"And in June 1927, the PCJ station had the great honor of receiving H.M. the Queen of Holland and H.R.H. Princess Juliana in its studio. The royal address to the Dutch East and West Indies was received with perfect clearness as stated in a radiogram received at Eindhoven exactly eight minutes after the last word was spoken by Her Majesty. On April 28 of that year, Beethoven's 9th Symphony, played by the Amsterdam orchestra and conducted by Dr. Willem Mengelberg, was broadcast to the world.

PCJ Today

The PCJ transmitter is now situated at Huizen, near the shores of the Zuider Zee. It has ten stages, with an output of some 30 kw. and a cooling-tower is used to keep the water-temperature of the cooling system at a constant low level.

The two antennas in use are both of the directional type. The first consists of a system of 8 sets of 3 vertical doublets, which are fed in phase, thus having the result of concentrating the energy. This beam is supported by two fixed masts and is oriented towards the Dutch East Indies.

The second antenna is of unique construction—the only one of its type in the world. This antenna is supported by a pair of 200-ft. wooden masts, fixed together on one undercarriage. This is fitted with 8 sets of two wheels, so that the whole structure can revolve upon two circular rails by means of two electric motors. In cases of need, two or three men can do the job. (One day in 1944, the station engineers loosened the brakes—and a fresh breeze did the rest!)

This revolving antenna consists of four sets of three vertical dipoles and as many reflector dipoles for 9590 kcs. One quarter-wavelength behind this system there is a similar one acting as reflector, which is fed with a voltage 90 degrees ahead in phase as compared with the antenna itself. The feeder is connected with the antenna feeder led over the rails by means of a bridge.

Studios from which the programs of PCJ emanate are located at Hilversum, about 20 miles southeast of Amsterdam, where the medium-wave broadcasts are also prepared and radiated.

Mr. Startz points out that "at the present time the transmitters are no longer operated by the Philips Laboratories, but by a semi-State institution called *Radio Nederland,* but all the credit for putting the Overseas Services from Holland into motion—until the war broke out—is due to the enterprise, foresight, and perseverence of Philips Radio, a thoroughly Dutch concern, with which I am still in close contact."

As to medium-wave radio service in Holland, two medium-wave transmit-

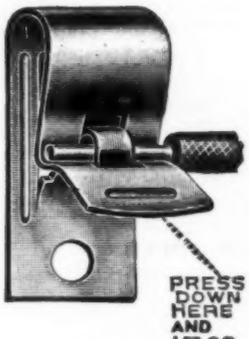
Fahnestock Clips

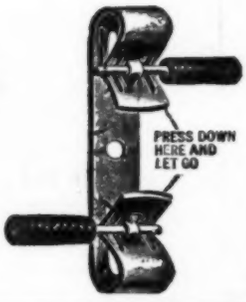
RADIO'S GREATEST CONVENIENCE

FAHNESTOCK SPRING BINDING POST GRIPS THE WIRE BY THE ACTION OF A SPRING

No tools required to make the connection. Grips the wire with just the right pressure for good electrical contact. Simply press down, insert the wire and let go. Does not injure wire, hence connection can be made or opened as often as desired. Available in large variety of types and sizes to fit any radio purpose and any requirement as to position, space or method of attachment. You will find them in the better sets.

Positive contact; cannot jar loose. Brass or bronze—nonrusting.





FAHNESTOCK ELECTRIC COMPANY, Inc.
46-44 ELEVENTH STREET
LONG ISLAND CITY 1, N. Y. Dept. 12

Please send us at once, Descriptive Literature, Prices and Delivery Schedule on

FAHNESTOCK CLIPS

For .....
Name .....
Address .....
City ..... *State* .....

Large Vacuum-Packed Tin of Delicious

PLANTERS PEANUTS ABSOLUTELY FREE!

Olson's New "Gift-of-the-Month"

The treat's on Olson—and what a treat! A big Half-Pound Tin of Planters famous Jumbo Peanuts—fresh, plump and tender! It's FREE to Olson customers. Why not be an Olson customer and get our free gifts, as well as really good radio parts?

Just fill out and mail the coupon below, and you're a member of Olson's FREE Gift-of-the-Month Club. No dues, we pay the gift bill! No obligation.
This month, a $10 purchase brings you one half-pound tin of Planters Peanuts FREE; a $20 purchase brings you TWO tins, etc.

If you do not have our latest Bargain Catalog, paste this coupon on a postcard and mail today!

OLSON **RADIO WAREHOUSE, INC.**
73 E. MILL ST., DEPT. 69, AKRON, OHIO

Please enroll me in Olson's Gift-of-the-Month Club and send me your catalog. If I order this month, I will receive free Planters Peanuts as offered above.

NAME_____
ADDRESS_____
CITY_____ STATE_____

ters are operated on 400 m. and 300 m., respectively. The programming is made by a half dozen independent associations—a neutral, a socialistic, a Catholic, a Protestant, and some smaller ones, all representing some major cultural current prevailing in Holland. There is a tax on radio sets from which the costs for the programs are derived. Broadcasting in Holland is still in the process of reorganization following war's end.

PCJ During the War

And that brings us to an important question that has ofttimes been asked: *"What happened to PCJ during the war?"*

Our answer to this question comes from a broadcast made by Mr. Startz shortly after PCJ returned to the airwaves after Germany's defeat:

"Here is the story in a nutshell. It began on the night of May 10th, 1940. The starlit sky over Holland was filled with the roar of planes. At 4 o'clock in the morning, PCJ's chief engineer broke the bad news . . . we were at war with Germany!

"There it was! The worst had happened!

"I slipped on my clothes and five

(*Continued on page* 129)

10 KC. Suppressor

(*Continued from page* 46)

quency speaker gave an attenuation of 14 db. as shown by the dotted curve of Fig. 2. This was not considered sufficient. Reference to an article entitled *"Graphics of RC Networks"* by Robert C. Paine in the May, 1944 RADIO-ELECTRONIC ENGINEERING edition of RADIO NEWS indicated a higher possible attenuation at the resonant frequency by the use of a resistor to balance out the resistance of the coil. The resulting circuit is shown in Fig. 1B, and the curve obtained with the final form of the filter is shown in Fig. 2 as the solid line. Figure 3 shows the curve plotted on the more conventional semi-log paper, and shows to better advantage the extreme sharpness of the filter network. C_1 and C_2 together resonate with the induct-

STANDARD WARRANTY PLAN

AT a recent meeting of the Association of Electronic Parts and Equipment Manufacturers recommendations were made for the adoption of a standard warranty to be used by manufacturers who sell radio parts distributors.

The proposed warranty contains certain provisions intended to bring out uniformity in the handling of defective products. The period of warranty is left for determination by the individual manufacturer.

The warranty has been submitted to the Sales Managers Club, Eastern Group, for its comments and will then be submitted to the Radio Parts Coordinating Committee for further discussion.

—30—

— BETTER VALUES from ARROW! —

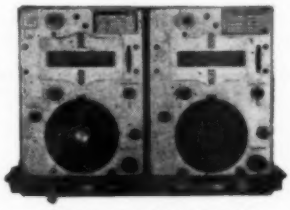
now offers the

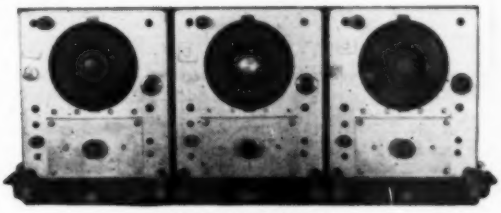
FAMOUS COMMAND SET

ARMY SURPLUS — Principal Components of RADIO SET SCR-274-N

Includes 2 transmitters, 3 receivers, 1 modulator, 4 dynamotors, control box, etc.

Original Cost Over $600.00— now complete for ONLY





$34.95

RADIO TRANSMITTERS

BC-457-A	BC-458-A
4—5.3 mc	5.3— 7mc
Ind. cost	Ind. cost
$10.95	**$10.95**

RADIO RECEIVERS

BC-454-A	BC-453-A	BC-455-A
3—6 mc	190— 550 kc	6—9.1 mc
Ind. cost	Ind. cost	Ind. cost
$6.95	**$8.95**	**$6.95**

MODULATOR UNIT

BC-456-A Ind. cost..... **$6.95**

A BUY YOU CANNOT OVERLOOK! ORDER AT ONCE!

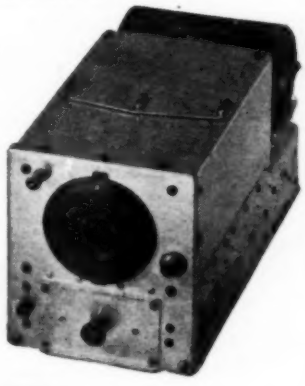
These components are practically new and have had ferry time only . . . complete with tubes . . . original cost over $600.00 . . . this tremendous value for only $34.95 complete . . . **less than the tubes originally cost!** Individual cost of dynamotors, $4.95 each . . . Ind. cost of Remote Control Unit (BC-450-A) $2.95.

COAXIAL CABLE

26 Ft. of COAXIAL CABLE RGU8, 52 ohm, with 2 amphenol plugs, one at each end.....ea. **89c**

ARMY AIRCRAFT RECEIVER
Model BC-946-B

Broadcast Band from 520 to 1500 kc. Tube complement: 3—12SK7, 1—12SR7, 1—12SN7, 1—12A6, & 1—12K8. Designed for dynamotor operation but is easily converted to 110 or 32 volt operation. Has two I.F. stages and three gang condenser. Comes packed in sealed carton complete with tubes and instruction manual, but less dynamotor.....**$12.95**



Dynamotor D M 32A.

Each.....$4.95

HEADPHONES

Signal Corps, 8000 ohms and 200 ohms, each..... **$2.49** 2000 ohms, Trimm, each..... **$1.79**

POWER TRANSFORMER—NAVY TYPE

159 ma; 6.3V at 6.5 amps; 5V at 3 amps.....Each **$3.29**

SURPRISE PACKAGE

For the experimenter, radio serviceman, handy man, repairman, "ham," hundreds of valuable miscellaneous radio parts. 10 pounds..... **$1.59**

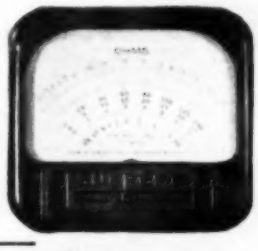
ANTENNA

10½ foot sectional antenna, collapsible. AN-131A..... **$1.29**

Wholesalers, dealers, institutions, and other quantity purchasers . . . write, wire, phone for quantity prices.

SUPREME FOUNDATION METER

40 Micro Amps. 25,000 ohms per volt. 4½" square. Mfd. by Supreme Instruments Corp. Each..... **$8.95**



HICKOK 2½" 0-150 Volt AC Voltmeter

Each..... **$2.49**

3½" AUTOMATIC TIME METER

60 cycle 110 volts. This time meter consists of a cyclometer driven by a Telechron synchronous motor. Connect to an electric circuit; it will measure and indicate the number of hours or minutes that the circuit is in use. Shpg. wt., 61 lbs.—list $17.00. Your cost..... **$4.95**

PLUGS

PL55 Plugs.....each **20c** PL68 Plugs.....each **20c**

JACKS

JK 26.....each **20c**

CARBON MIKE

T-17-B Carbon mike.....each **$1.49**

VEEDER-ROOT METER and CASE

Counts number of feet of trailing wire antennae; number turns when winding on coil applicable for many uses; flexible shaft can be attached and connected to another device for counting without direct attachment; speed 300 ft. per minute for reeling out; beautiful bakelite case, jeweled dialite, pilot light enclosed, 3 position switch, counts up to 1000. Each..... **95c**

All shipments F.O.B. Chicago. 20% deposit required on all orders.

Dept. C

ARROW SALES, INC.

59 WEST HUBBARD STREET • CHICAGO 10, ILLINOIS

Telephone: SUPERIOR 5575

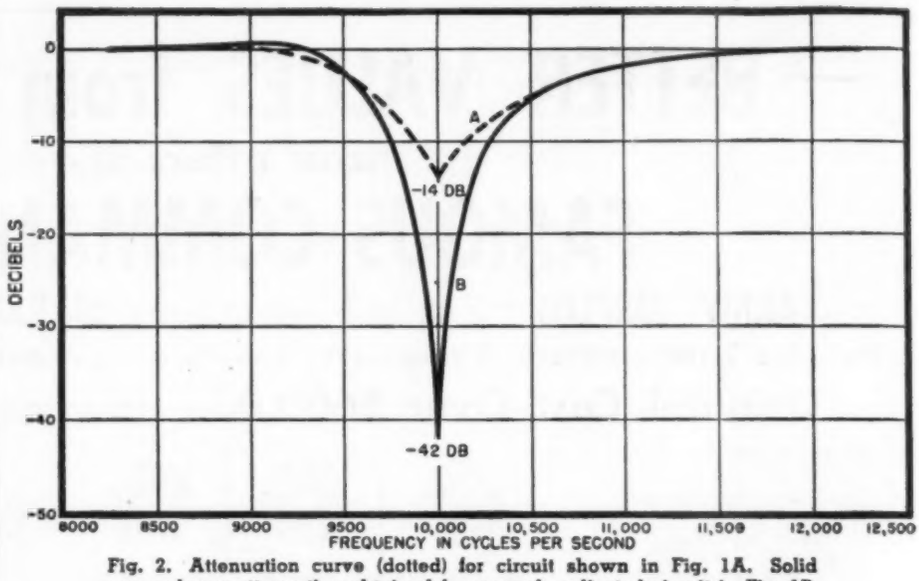


Fig. 2. Attenuation curve (dotted) for circuit shown in Fig. 1A. Solid curve shows attenuation obtained for properly adjusted circuit in Fig. 1B.

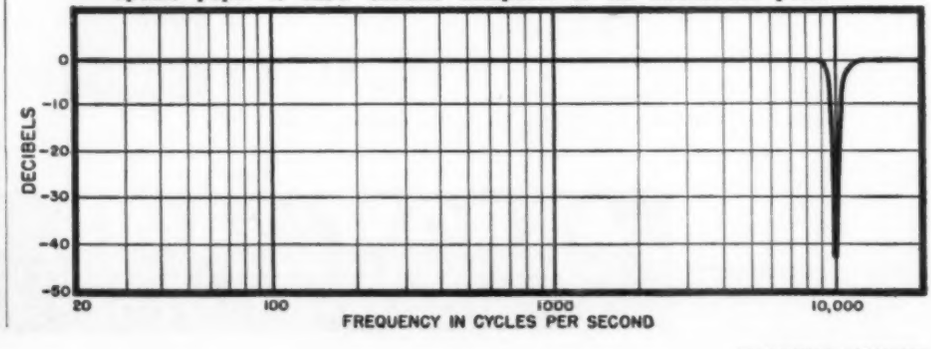
ance at 10,000 c.p.s. With the circuit set up as in Fig. 1B, with a 15 ohm rheostat in place as R and adjusted for maximum suppression at 10,000 c.p.s., the solid curve of Fig. 2 was obtained, showing a loss of 42 db., which very effectively eliminates the objectionable frequency. This curve was obtained with a value of 10 ohms for R. Since R is equal to four times the effective resistance of the coil, the resistance of coil L is therefore 2.5 ohms. At 10,000 c.p.s., the coil has a reactance of 64 ohms, and the Q is therefore X/R, or 64/2.5, or approximately 26. Referring to the curve of Fig. 2, it will be noted that it is flat to 9200 c.p.s., and only down 6 db. at 9600 c.p.s. On the other side of the resonant frequency, the curve is down 6 db. at 10,600 c.p.s., down 2 at 11,000 c.p.s., and flat at 12,000 c.p.s. Thus it is seen that a very small part of the frequency spectrum is "clipped" out of the over-all response.

This sounds almost ideal, but there *is* a disadvantage to this filter. There is a loss of about 2 db. in the main pass band of this filter. In the original circuit, the filter was inserted in the high-frequency leads of a speaker system in which the impedance was 16 ohms. R was determined to be 10 ohms. The reactance of each capacitor at 1000 c.p.s. for example, is 1280 ohms, so the shunting effect of the capacitors is negligible. But the resistor R is in series with the circuit, and the loss due to it is approximately 2 db. When used in the circuit of a high-frequency horn, this disadvantage may be overlooked since the high efficiency of the high frequency speaker is such that there is generally some attenuation in that circuit between the dividing network and the speaker itself. This attenuation can be reduced by the necessary amount to compensate for the loss in the filter.

A Practical Filter and Circuit

To avoid the necessity of winding the coil, it is entirely possible to make this filter from standard parts. The *J. W. Miller Company* of Los Angeles makes a line filter coil, #7825, which will serve for the inductance in speaker circuits having an impedance of around 8 ohms. This coil has an inductance of .6 mh., which calls for a capacitor of .42 μfd. to resonate at 10,000 c.p.s. Since this value is not a standard commercial size, C_3 and C_4 are each .25 μfd. paper capacitors. Connect them as in Fig. 1C, using a 15 ohm, 10 watt adjustable resistor (*Ohmite* #1007). If an audio oscillator and a sensitive a.f. voltmeter is available, the variable resistor can be adjusted for maximum suppression with very little effort. This combination of coil and capacitors will resonate at around 9200 c.p.s., assuming they have values close to their ratings.

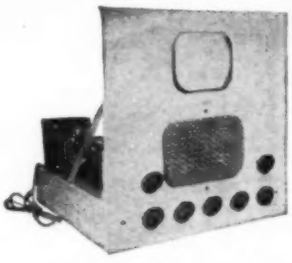
Fig. 3. Curve shown is the same as that illustrated as a solid curve in Fig. 2 except for the fact that it is plotted on semi-log frequency response paper to show extreme sharpness of the attenuation peak.



Metropolitan

fills Mail Orders *Same day received!*

New TELEVISION RECEIVER KIT



Easy to assemble. No knowledge of television required. Complete easy-to-follow instruction sheet gives you *all* the knowledge you need. Finished Television Receiver has a picture that is clear and sharp . . . comparable to a moving picture.

All necessary components are included: nothing is required except a screw driver, cutting pliers and a soldering iron. Only the highest quality standard parts are used—the list price value of these parts alone is more than $300. 110 volts, 60 cycles AC.

FACTORY GUARANTEE—set guaranteed to operate satisfactorily if directions are followed exactly. Servicing of component parts and assembled parts will be performed by the factory at factory costs.

$159.50

The New Model B-45 BATTERY OPERATED SIGNAL GENERATOR

for servicing AM FM Television Receivers

Self-modulated Signal Generator, providing a highly stable signal. Generates R.F. frequencies from 150 Kilocycles to 50 Megacycles (150 Kc. to 12.5 Mc. on Fundamentals and from 11 Mc. to 50 Mc. on Harmonics). R.F. is obtainable separately or modulated by the Audio Frequency.

Direct reading—all calibrations are etched on the front panel. Complete with shielded test lead, self-contained, batteries and instructions. Net.....

$27.75

We carry nearly 5,000 instruments in stock. All models listed below are available for *immediate* delivery.

(1) PRECISION APPARATUS INSTRUMENTS

832S—31 Range AC-DC Multi-Range Tester	$23.04
844P—34 Range AC-DC 600 volts AC and DC VOLT-OHM MILLIAMMETER	32.20
856P—44 Range Super-Sensitive, 20,000 ohms per volt AC-DC TESTER	49.94
864—AC-DC VOLT-OHM-DECIBEL-MILLIAMMETER with large 9" meter	59.60
912P—Dynamic Mutual Conductance Tube Tester	61.20
E-200—A.M.-F.M. and Television Signal Generator	64.15
EV-10P—6000 volts AC and DC Vacuum Tube Multi-Range-Meter	71.81
920P—Combination Dynamic Mutual Conductance Tube Tester, Battery Tester and 33 Range AC-DC Multi-Range Set Tester	84.22
954P—Combination Dynamic Mutual Conductance Tube Tester, Battery Tester and 37 Range Super-Sensitive AC-DC Multi-Range Set Tester, 20,000 ohms per volt DC	99.20

(2) SUPREME INSTRUMENTS

543—Multi-Tester	$18.95
589—Tube and Battery Tester with Roll Chart	48.95
599—Tube and Set Tester with Roll Chart	62.50
565—Vacuum Tube Voltmeter	63.50
576—Signal Generator	68.95
805—Combination Tube and Set Tester with Roll Chart	89.50
546—Oscilloscope	89.75

(3) McMURDO SILVER CO.

905—"Sparx" Dynamic Signal Tracer	$39.90
904—Capacitance Resistance Bridge	49.90
900—"Vomax" Vacuum Tube Voltmeter	59.85
906—A.M.-F.M. Signal Generator	89.90

(4) RADIO CITY PRODUCTS

447—Multi-Tester	$17.95
448—Multi-Tester	24.50
322—Dynoptimum Tube Tester	41.50
461-P—Sensitive Multi-Tester 20,000 ohms per volt DC	42.63
664—Electronic Multi-Tester	45.00
705—Signal Generator	49.50
315—Rollchart Tube Tester	59.50
802N—Combination Tube and Set Tester	59.50
668—V.T.V.O. Capacity Meter	73.01
805—Combination Tube and Set Tester	89.50
665A—V.T. "Billionaire" Insulation Tester plus VTVM	92.61

(5) SUPERIOR INSTRUMENTS

CA-11—Signal Tracer	$18.75
670—Super Meter	28.40
CA-12—Audible-Visual Signal Tracer	34.85
450—Tube Tester	39.50
650—Signal Generator	48.75
400—Electronic Multi-Tester	52.50
600—Combination Tube and Set Tester	62.50

(6) SHALLCROSS MFG. COMPANY

Decade Resistance Boxes	$13.50
Portable Galvanometers	27.50
630—Wheatstone Bridge	75.00
637—Kelvin Wheatstone Bridge	100.00
638-2—Kelvin Wheatstone Bridge	150.00

(7) ALLEN B. DUMONT LABORATORIES

185A—Electronic Switch and Square Wave Generator	$105.00
274—5" Oscilloscope	115.50

(8)

WATERMAN "Pocket" Oscilloscope	55.00
MONITOR Crystalliner Signal Generator	57.50
Bliley Crystal Controlled Signal Generator	69.50
WESTON—689-1F Ohmmeter, including leather carrying case, list $25.50	14.85
200—Electronic Measurements Mutual Conductance Tube Tester	49.85

TERMS: 25% deposit, balance C. O. D.
or Full Payment with order
SEND FOR FREE CATALOG!

Metropolitan ELECTRONIC & INSTRUMENT CO.
Dept. R, 6 MURRAY STREET
NEW YORK 7, N. Y., U. S. A.
Cable Address: METRONICS
Phone: BArclay 7-5556

To resonate at 10,000 c.p.s., remove a few turns at a time from the coil until the circuit offers a maximum suppression at 10,000 c.p.s. If no a.f. oscillator is available, this will have to be done by ear, using the station from which the most trouble with the 10 kc. whistle is encountered. The number of turns to be removed will be somewhere between 8 and 12, so it is suggested that it be done very carefully.

If an accurate bridge is available, connect the two capacitors in parallel, and measure their capacitance. Then calculate the required inductance by means of the formula (for a frequency of 10,000 c.p.s): $L = .254/C$ where L is in millihenries and C is in microfarads. Then using the bridge, the coil may be adjusted to the required inductance.

The same circuit can be used in 500 or 600 ohm lines, using good coils with an inductance in the order of 300 to 500 mh. When the resistance is adjusted for the coil selected, the rejection is theoretically infinite at the resonant frequency. Both capacitors should have the same value, and the adjustment of the resistance is critical.

When connected in low-level circuits, it is simple to compensate for the insertion loss by increasing the gain of the following amplifier by the required amount.

This filter is not recommended for use in speaker circuits where a large amount of power is being supplied, since the losses are too great, but for ordinary residence radio use, it will generally be satisfactory to install it in this manner, since the speaker power requirements are rarely high enough for the losses to be objectionable.

—30—

ELIMINATE GLARE FROM PROBE LAMP

A PROBE lamp of the type shown, unless shielded, is difficult to look past at a near point—such as in a dark corner of a radio chassis.

A small piece of adhesive or friction tape applied on one side as illustrated will improve the usefulness of this tool. . . . . H.L.

Save up to 80% at Sun Radio...

ON BRAND NEW RADIO TUBES!

War Surplus Equipment!..

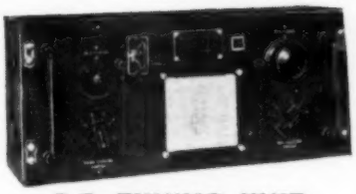
AT A FRACTION OF THEIR ORIGINAL GOVERNMENT COST

ALL STANDARD BRAND TUBES

Number	Price	Number	Price	Number	Price
0Z4	$1.45	6F5	$1.00	12SF5GT	$1.00
1A7	1.80	6F6	.95	12SJ7GT	1.10
1B4	.80	6F7	1.50	12SK7G7	1.10
1B7	.80	6F8	1.10	12SL7GT	1.20
1C5GT	1.00	6G6	1.00	12SN7GT	.95
1D5	.80	6H6	.75	12SQ7GT	1.10
1D8GT	1.10	6J5	.80	12SR7	1.00
1E4	.80	6J7	1.15	14A7	1.50
1E5	.90	6J8	1.30	14B6	1.40
1E7	1.00	6K6	.85	14B8	1.60
1F4	.80	6K7	.85	14C5	1.60
1F5	.80	6K8	1.30	14C7	1.60
1F7	.90	6L5	1.10	14F7	1.60
1G4	1.30	6G5	.95	14H7	1.60
1G6	1.25	6L6G	1.50	14J7	1.60
1H4	.70	6L7	1.40	14N7	1.60
1H5	1.50	6N7	1.40	14Q7	1.20
1J5	.75	6P5	.80	14S7	1.60
1J6	.80	6P7	1.40	14W7	1.85
1LA4	1.95	6Q7	1.30	14Y4	1.60
1LB4	1.95	6R7	1.40	18	1.25
1LC6	2.70	6S7	1.20	19	1.00
1LD5	1.95	6SA7	1.00	20	1.75
1LH4	1.95	6SF5	.70	22	1.00
1LN5	1.95	6SJ7GT	.70	24A	.90
1N5	1.30	6SK7GT	.80	25L6GT	1.10
1R5	1.25	6SL7GT	1.00	26	.75
1S4	1.25	6SN7GT	.85	27	.70
1S5	1.25	6SQ7GT	1.00	30	1.00
1T4	1.25	6T7	1.00	31	1.00
1T5	1.50	6U6GT	1.00	32L7GT	1.95
1V	1.00	6U7	1.00	33	1.00
2A6	.75	6V6	1.10	34	.80
2B7	.75	6V7	1.00	35W4	1.08
2E5	.65	6W7	1.20	35Z3	1.30
2X2/879	.90	6X5GT	1.00	36	1.00
2Z2/G84	.45	6Y6G	1.00	37	.75
3A8	1.95	7A4	1.00	38	.85
3Q5	1.95	7A5	1.00	39/44	.80
3S4	1.25	7A6	1.00	41	.85
5U4	1.00	7A7	1.00	42	.85
5V4	1.60	7B4	1.00	45	.80
5X4	1.10	7B5	1.00	46	1.00
5Y3GT	.70	7B6	1.00	49	.95
5Y4	.75	7B8	1.30	50	1.75
5Z3	.95	7C5	1.00	50L6	1.24
6A5	1.70	7C6	1.30	55	.50
6A6	.80	7C7	1.00	56	.80
6A8	1.00	7E6	1.00	57	.75
6A5G	1.70	7E7	1.30	59	.80
6AC5GT	1.00	7F7	1.30	76	.75
6AF5	1.00	7H7	1.50	77	.75
6AF6	1.60	7J7	1.50	78	.75
6B4	1.50	7L7	1.50	79	.85
6B7	.95	7N7	1.50	80	.60
6B8	1.00	7Q7	1.00	81	1.50
6C5	.98	7R7	1.30	82	.85
6C6	1.00	7S7	1.50	83	1.30
6C7	.45	7V7	1.80	83V	1.95
6C8	1.25	7W7	1.00	84/624	1.10
6D6	.75	7Y4	1.30	89	.40
6D7	1.00	7Z4	1.30	99	1.50
		12BE6	1.44	117L7GT	2.35
		12F5GT	1.00	117Z6GT	1.60
		12J5GT	1.00	XXB	1.50
		12SA7GT	1.30	XXFM	1.50
				XXL	1.50

10% discount given for orders over 100 tubes

• All items F.O.B. Washington, D. C. Orders $30.00 or less, cash with order. Above $30.00, 25% with order, balance C.O.D.



R.F. TUNING UNIT

Comes in a beautiful black crackled aluminum cabinet with two Variable Transmitting Condensers and two Vernier dials, one heavy duty ceramic four position wafer switch, two or more mica condensers 2,500 Working Volts and coils wound on porcelain ribbed forms.

Yours for only..... $3.89

No. TU5B	1500	to	3000 KC
No. TU6B	3000	to	4500 KC
No. TU7B	4500	to	6200 KC
No. TU8B	6200	to	7700 KC
No. TU10B	10,000	to	12,500 KC

Please specify model

NAVY V.H.F. RADIO TRANSMITTER

$9.95

LESS BATTERY

BRAND NEW

Battery operated (67½ V.B. and 1½ V.A.) Frequency 80 to 105 M.C. Complete with 2-1G4 tubes and full instruction manual.

HALLICRAFTER SP44 PANORAMIC ADAPTER

For immediate delivery. Easily installed in any Set. Shipping charges prepaid in full to your home... $99.50

WALKIE TALKIES

$69.95 EACH

$129.90 SET

SCR195 Walkie Talkies, brand new, weight 27½ pounds including knapsack. Range up to 25 miles in open country. Frequency 52.8 to 65.8 MC. Transmitter and receiver with regular hand set. Complete ready to operate with spare parts.

NAVY ANEMOMETER

$14.95

Less Batteries

Battery 60c

Beautiful precision designed instrument that will enable you to determine the Wind Velocity in miles per hour. Complete instructions. 6 Volt battery operated. Brand new.

Complete 4 Tube INTERPHONE AMPLIFIER

Yours for only

$8.95

Comes in an aluminum cabinet 9¾x4¾x5½ inches with two 12J5GT and two 12A6 tubes; also Electric Dynamotor 28DC Volt input and 250 V DC output at 60 MA. Complete instructions and diagram for high fidelity phonograph or speech, 110 Volt operation. Greatest offering ever made in War Surplus Electronics!

RHOMBIC RECEIVING ANTENNAE

Complete with all accessories including 2200 feet of No. 14 copper weld wire, 50 feet of heavy twin X lead 72 ohm good up to 2 KW, dozens of insulators, pulleys, neon lightning arrestors, ground rod....less poles.... Only $24.95

SCR 536 B2 HANDIE TALKIE CHASSIS

Comes completely wired with 1-1R5, 1-1T4, 1-1S5, 2-3S4 Tubes and two 455 KC iron core I.F. transformers less antenna, output coil, and crystals.

$9.95

OHM METER WESTON #689

A beautiful instrument for accurate work. Scale 0-10 ohm and 0-1000 ohm scaled to read 1/20 of an ohm with ease. This 2¼" round meter is housed in a black bakelite case 1⅝"x2¾"x5". Complete with heavy duty felt-lined leather case and lock. net.

$14.97

SUN RADIO

OF WASHINGTON, D. C.

938 F STREET, N. W. WASH. 4, D. C.

4-Watt Amplifier

(*Continued from page 40*)

The actual wiring of the tube sockets, etc., is done first. As much of the wiring on the underside of the top plate as possible is completed before this plate is placed on the main part of the utility box. Wires going to the two volume controls, the power switch, the two input jacks, the output transformer, and the filter choke are terminated at solder lug terminal strips located at strategic places to be connected to those components after the top plate is in place.

Adequate filtering and shielding within the amplifier is necessary to keep hum at a minimum. The filtering is provided for by the filter choke with two 50 μfd., 150 w.v. filter condensers bypassing it, and by the 25,000 ohm decoupling resistor R_{11}, and the 20 μfd., 150 w.v. decoupling condenser bypassing it. Shielding is provided by placing a small coil shield can over the underside of the 6SJ7 tube socket after all wiring connections have been completed. The wires to the cathode resistor and condenser, the screen bypass condenser, the "B" plus decoupling condenser ("B" plus power supply), and also to the coupling condenser C_3 are brought out from under this shield can by making small notches around its edge to clear each of these wires. The wire to the microphone jack is brought out through a grommet inserted in the top of this shield can. Several things should be carefully noted in the manner of shielding and grounding the various wires in the amplifier. The wires running between the two gain controls,

RADIO SHOP AT BARKER BROS.

By MARK McMILLIN

BARKER BROS., Los Angeles, recently opened its newly enlarged and decorated Radio Shop, which has at once established itself as one of the finest on the Pacific Coast. One-half block in length, and conveniently situated on the huge oblong mezzanine, the new shop is extremely spacious, colorfully decorated in the modern style, and unusually complete in every detail.

Beige and soft turquoise, with touches of off-white, are the colors used in the handsome decorations. The carpeting is of light beige, with chairs of a lighter shade. The woodwork and walls are of soft turquoise, trimmed with off-white. Likewise the counters and display racks are of the same tones. All lighting is indirect.

At one end of the department are eleven audition rooms, five large and six small. The shop is equipped with all the leading makes of radios, phonographs, and combination sets, including Hoffman, General Electric, Zenith, Crosley, Westinghouse, Tempo-Tone, Musaphonic, Sentinel, Packard-Bell, RCA Victor, Emerson, Echophone, and others. In addition, the shop carries a complete line of records and record albums and all the other accessories to appeal to radio and phonograph fans.

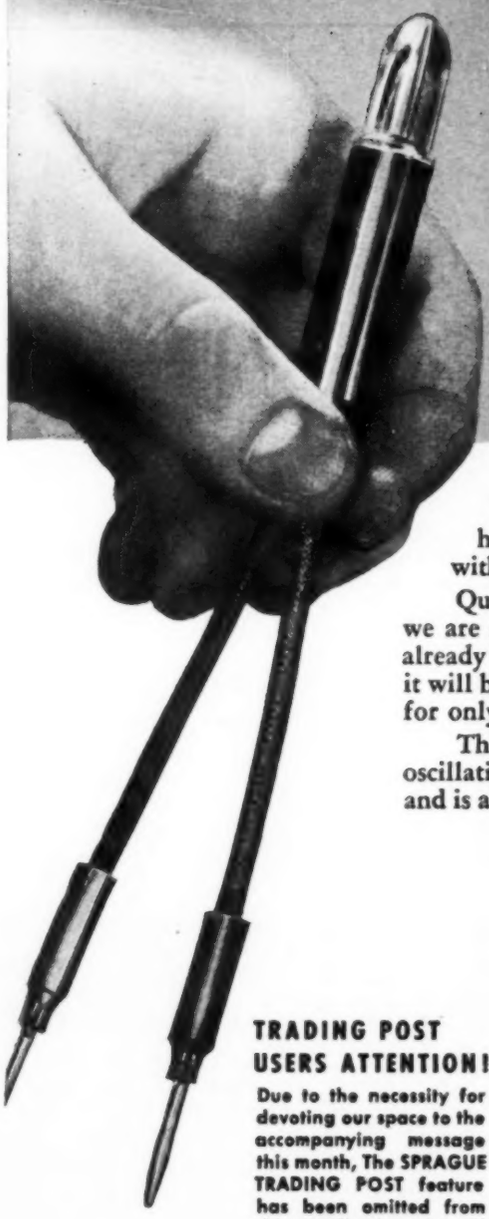
At the far end of the department, the entire wall is covered with a huge frosted glass map of the world, showing the radio waves joining the various hemispheres. This is indirectly lighted from behind, and is especially appealing to patrons and other visitors. The new Radio Shop is so comfortable, handsome, and completely equipped that it has rapidly become one of the favorite shopping spots of Los Angeles shoppers.

—30—

The well-planned Radio Shop at Barker Bros., Los Angeles, is one-half block in length and handsomely decorated in modern style. The world radio map, to be seen on the rear wall, is a feature which has found wide appeal among the store's patrons.

AMATEURS!

WHAT ARE YOU GOING TO BUILD?



Fill Out the SPRAGUE Questionnaire

WE'LL GIVE YOU THIS HANDY TESTER

for only 25¢ to cover cost of packing and mailing.

Here's how you can help us: Sprague Capacitors and Koolohm Resistors have never been matters of guesswork. Now, to tie them in even more closely with amateur requirements, we are conducting an extensive research.

Questionnaires have already been mailed to several thousand amateurs. In them, we are asking about future building plans and needs for their rigs. If you have not already received a questionnaire, write for one today. You'll enjoy filling it out — it will be mighty helpful to us — and to repay you, we'll send a Sprague Handy Tester for only 25c cash or stamps to defray cost of packing and mailing.

The Handy Tester tests ac-dc voltages up to 500v; indicates r-f and parasitic oscillations; checks charge on high-voltage capacitors, distinguishes a.c. from d.c. and is a tool of dozens of other uses.

Sorry, but of course we've got to limit this offer — and the questionnaires — only to licensed amateurs.

Write today to Dept. RN-37

TRADING POST USERS ATTENTION!

Due to the necessity for devoting our space to the accompanying message this month, The SPRAGUE TRADING POST feature has been omitted from this publication. It will appear again next month.

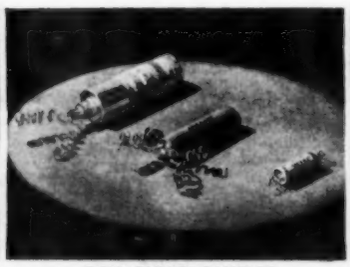
SPRAGUE

PRODUCTS COMPANY

NORTH ADAMS, MASS.

PAPER DIELECTRIC

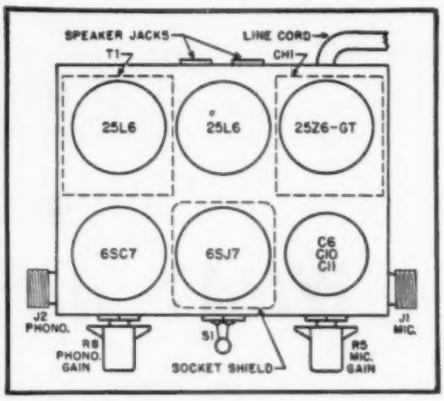
MICA CAPACITORS



DRY ELECTROLYTICS

KOOLOHM RESISTORS

Trademark Reg. U. S. Pat. Off.



Mechanical layout shows relative position of the various component parts.

and from the gain controls to the amplifier assembly proper should be shielded. All ground connections in the microphone pre-amplifier circuit (the 6SJ7) should be *grounded at one place.* Hum will be introduced if this instruction is not carefully followed. It should be noted that the shielding on all wires, and the ground return circuit from the microphone and phonograph jacks, is connected to the *amplifier* ground and not the *chassis* ground. The only shielding connected to the chassis ground is the can covering the base of the 6SJ7. All other shielding is connected to the amplifier ground. Since this is a.c.-d.c. equipment and the amplifier ground must necessarily be connected directly into one side of the line power cord, the chassis is isolated from the amplifier ground by the condenser C_9. The microphone and phonograph input jacks must be insulated from the chassis by fiber grommets. These jacks, as has been already stated, are grounded to the amplifier ground.

Beyond the observations that have just been made, the points in the construction of this amplifier are conventional. It should be noted that the filter condenser is grounded to the amplifier ground, and is mounted on the chassis by an insulating fiber plate.

-30-

SERVICEMEN GET RAISE

SEATTLE, Washington radio and appliance servicemen have been granted a 15% wage increase and a 40-hour week for all shops by terms of a new contract recently signed by the Association of Appliance Dealers and the Radio Service Unit, Local B-77 of the I.B.E.W.

The new agreement affects nearly 250 servicemen employed by approximately 175 radio and appliance dealers, service shops and furniture stores with service departments. Department stores are covered by another contract.

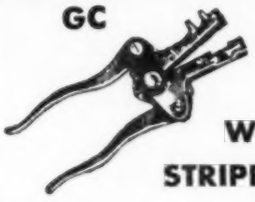
Retroactive to October 1, 1946, the wage rate for full-time and part-time journeymen was raised from $1.30 to $1.50 per hour while the rate for shop managers was lifted from $1.45 to $1.65, thus maintaining the 10% differential over the journeyman wage.

Other contract changes further define holiday pay and shop manager provisions. -30-

Get an EYEFUL of these values!

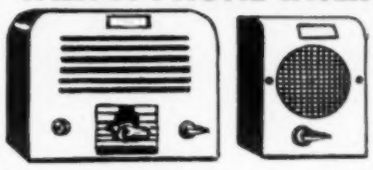
BEST BUYS in PARTS and EQUIPMENT

GC WIRE STRIPPER



Automatic Model	$ 4.80
Standard Model	3.60
Deluxe Complete Kit	10.20
Extra Blades, any size	.90

TALK-A-PHONE INTER-COMS



KR-4010 Special Deluxe Master	$35.70
RU-4335 Sub-Station	9.77
4433 Cable, per 100 feet	6.20
KR- 40 Deluxe Master	41.30
RU- 43 Deluxe Sub-Station	13.27

Look at This Buy!

Portable Voice and Code Radio RECEIVER-TRANSMITTER

BC-654-A is a combined transmitter and receiver designed for portable or vehicular operation. The frequency range of both transmitter and receiver is continuous from 3700 to 5800 kilocycles; all stages gang tuned by anti-back lash worm gear dial mechanisms.

The BC-654-A is 18" wide, 14" high, and 9½" deep. Weight 44¾ pounds. Power required for Receiver—1.5, 45, and 90 volts D.C. Power required for Transmitter—1½, 6, 51, 84 volts D.C. and 500 volts D.C. at 160 ma. Operates from Dynamotor PE-103-A.

Extra Special **$22.95**

Complete with case less dynamotor

One-third deposit with order, balance C.O.D., F.O.B. shipping point.

LAST MINUTE SPECIALS

Weller Soldering Gun	$12.95
Clarkstan 2 Meter Ring Tuner	4.80
Clarkstan Needle Pressure Gauge	1.80
BA-303 Hushatone	6.83
Brush Model "A" Headphones	7.20
Brush Vibromike	10.26
IF Transformers	.69
Resistor Kit (100 Asst. Resistors)	2.55
Replacement Loops	.48
Bar Knobs, 10 for	.45
Appliance Cord, 6-foot length	.19
Antenna Hanks, 20 ft., 10 for	1.50
JT-30 Astatic Mike with stand	10.17
GC Alignment Kit	3.90
GC Neutralizing Kit	4.50
Antenna Kit—50-ft. Wire, Insulators	.73
Riders Manuals—X, XII, XIII, etc.	15.00

WIRE

SV-18-2 Cord, 250 feet	$9.63
Hook-Up Wire, 100 feet	.51
RCA Bright Picture Wire, per foot	.05
Aerial Wire, 50-foot coils	.71
Rubber Covered Lead-in, per foot	.01

RG-8-U CABLE

Flexible Coax

Impedance 52 ohms. Maximum operating voltage, 4000 volts.

1 to 100 feet, per foot	$0.08
100 feet and up, per foot	.05½

PEERLESS—HALDORSON—STANCOR TRANSFORMERS

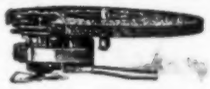
P-38—660 volt CT at 50 ma-5 volt 2A-6.3 volt 1.6A	$3.18 Net
P-39—700 volt CT at 75 ma-5 volt 3A-6.3 volt 2.5A	$3.81 Net
P-40—825 volt CT at 200 ma-5 volt 3A-6.3 volt 6A CT	$7.89
P-41—750 volt CT at 300 ma-5 volt 4A-6.3 volt 5A-2.5 volt 10A	$15.48

RCA and CINAUDAGRAPH SPEAKERS

12" PM—2.8 oz. magnet	$9.33
6" 1000 Ohms Field	3.95
6" 4 Ohms Field (auto)	3.95
5" PM	3.27
4" PM	2.25
6" Elliptical	4.62

ALLIANCE and WEBSTER Phono Motors

Alliance **$3.91**



Webster **$6.17**

Sturdy replacement motor and turntable designed for long life.

TEST EQUIPMENT

Simpson 260 Multimeter	$38.25
Simpson 230 Multimeter	26.50
Triplett 666H Multimeter	20.00
Speco Signal Tracer	49.50
Speco Capohmist	16.95
McMurdo Silver Sparx	39.90
McMurdo Silver Vomax	59.85
McMurdo Silver CR Bridge	49.90
Jackson 645 ETVT	75.00
Speco Signal Tracer (battery)	29.95
Monitor Frequency Standard	37.50
0-1 MA DeJur Meter	4.25
0-500 MA Triplett 3"	4.50
8½" Marion Foundation Meter	20.00
Triplett Signal Generator	88.50
Triplett 20,000 Ohm p/u Meter	58.50

BC-645—VMF IFF RECEIVER-TRANSMITTER

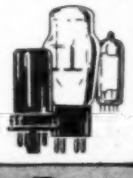
Ideal for converting to high frequency receiver-transmitter.

A 15-tube Interrogator Transponder designed for airborne use. It will operate from either a 12VDC or 24 VDC power source when used with the PE-101 dynamotor. The receiver is fixed tuned to 470 mc, but can be tuned from 461 mc to 493 mc. Can be made to tune in the 425 mc to 450 mc amateur band. **$17.95**

Ask for conversion instructions and schematics.

TUBES — ALL TYPES

Ask to be placed on our tube mailing list. Send us your orders.



D & H DISTRIBUTING CO. INC.

311 S. CAMERON ST. HARRISBURG, PENNA.

PARTS DIVISION

31 E. LEE STREET BALTIMORE 2, MD.

"IT'S **D & H** FOR DEPENDABLE PARTS SERVICE"

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

OHM'S LAW CALCULATOR

Ohmite Manufacturing Company of Chicago has announced the availability of their new Ohm's Law Calculator which incorporates several unique features.

The new calculator, like the previous ones, provides a simple and handy means of evolving resistance calculations. With one setting of the slide it gives the answer to any Ohm's Law problem. It will also solve parallel resistance and series capacitance problems and will multiply, divide, and find squares and square roots. The range covers all currents, resistances, voltages and wattages commonly encountered in industrial and radio work.

All computing scales of the new calculator are printed on one side. On the opposite side are given the Composition Resistor Color Code and the catalogue number of stock resistors and rheostats of various resistance values manufactured by the company.

Copies of this calculator are selling for 25 cents and may be secured from *Ohmite Manufacturing Company*, 4937 Flournoy Street, Chicago, Illinois.

APPLIANCE PROMOTION

Of interest to radio dealers who handle an appliance line is the new 24-page, full-color book issued by *General Electric Company*.

The booklet, entitled "Does Your Home Have a Place for Living," covers suggested plans for various appliance installations in the modern home. The planning of various service areas is discussed fully and completely illustrated.

Dealers who wish to secure a copy of this handy guide to electrical living should address their requests to the Advertising Division, *General Electric Company*, Bridgeport, Connecticut. The booklet carries a charge of ten cents per copy.

RECEIVING TUBES

Radio Corporation of America has recently issued a new 16-page booklet entitled "Receiving Tubes for Television, FM and Standard Broadcast" which is currently available for distribution.

This booklet charts the characteristics and socket connections of the company's line of receiving tubes, including projection and direct-view kinescopes. All types are listed in numerical-alphabetical sequence of type designations for the convenience of the user. Metal and miniature types are separately identified. Information on discontinued tube types has been included for the benefit of radio servicemen.

An added feature is the special chart which classifies *RCA* receiving tubes according to their functions and their cathode voltages.

Copies of Form 1275-B are 10 cents each and may be obtained from *RCA* distributors or direct from Commercial Engineering, Tube Department, *Radio Corporation of America*, Harrison, New Jersey.

SERVICE MANUAL

A complete service manual, covering every model of "Porta Power" together with full parts lists, is being offered by *General Transformer Corporation* of Chicago.

Designed specifically to aid radio servicemen and dealers, this manual contains full servicing information to speed repairs.

Copies will be sent to those who request them from *General Transformer Corporation*, 1260 West Van Buren Street, Chicago, Illinois.

ELECTRONIC COMPONENTS

Of interest to design engineers and purchasing agents is the new Catalogue 200 recently issued by *Cambridge Thermionic Corporation* of Cambridge, Massachusetts.

This new 20-page, tabbed-section catalogue contains specification sheets covering the company's line of terminal lugs, terminal boards, slug-tuned coils and swagers.

Copies of Catalogue 200 will be forwarded upon request to Department 8, *Cambridge Thermionic Corporation*, 445 Concord Avenue, Cambridge, 38, Massachusetts.

TUBE BOOKLET

Just off of the press and available from the company's distributors is the new *RCA* 16-page booklet, "Power and Gas Tubes for Radio and for Industry."

This booklet contains technical information on 138 *RCA* water- and air-cooled power tubes, voltage regulators, thyratrons, ignitrons and gas rectifiers. Each tube is covered by a text description and ample tabulated data, together with a terminal diagram.

Copies of this publication (PG-101) are available at *RCA* distributors or from Commercial Engineering, Tube Department, *Radio Corporation of America*, Harrison, New Jersey. The booklet is priced at 10 cents a copy.

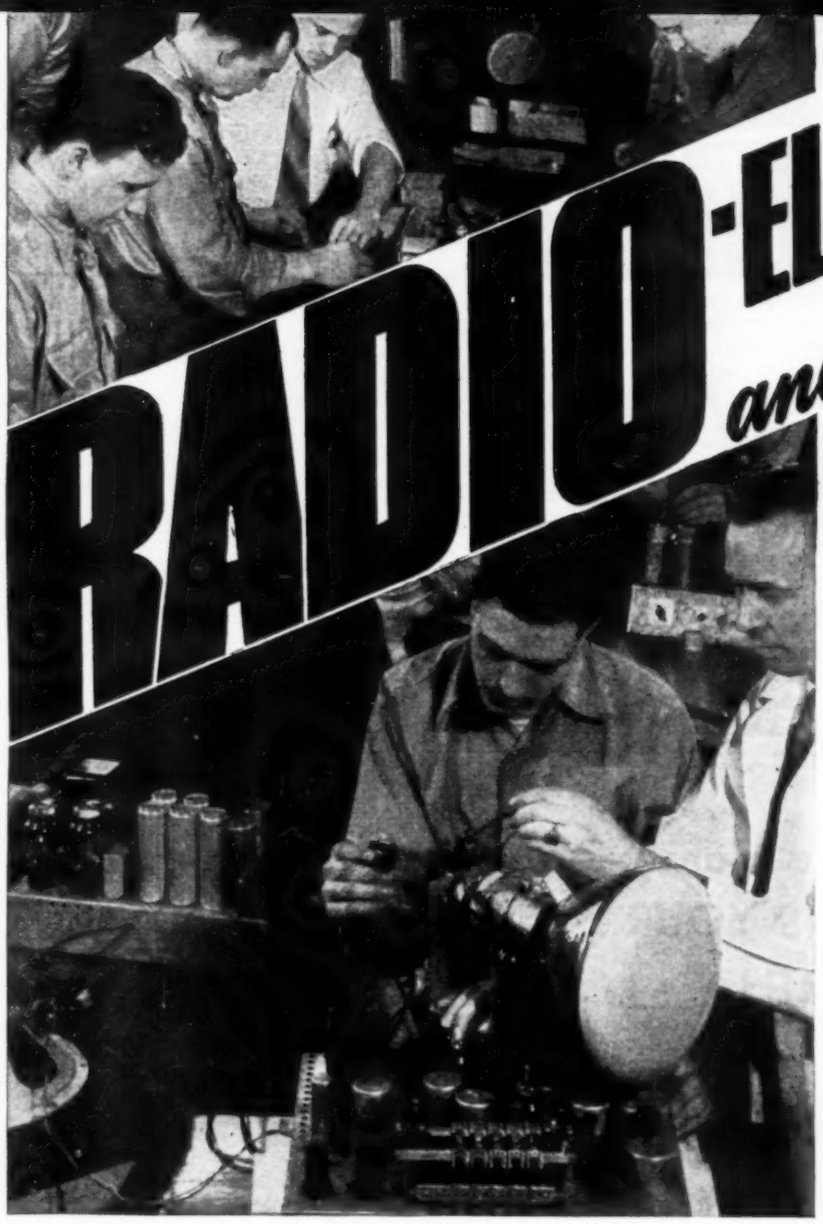
HYTRON TUBE GUIDE

Hytron Radio and Electronics Corporation is currently distributing copies of their new "Reference Guide for Miniature Electron Tubes."

Designed to be inserted in regular servicing binders, this guide lists in

Men! You Need "All-Around" Training for Tomorrow's Better Jobs in

RADIO-ELECTRONICS and TELEVISION



"Learn by Doing"

A FEW FASCINATING WEEKS of STREAMLINED TRAINING

You like Radio work. But if you're really serious about making it your lifetime career, GET PRACTICAL TRAINING NOW. Don't be satisfied to putter along in a "one-operation" no-future job. Prepare for better pay and advancement with **Coyne all-around** training in Radio.

Many Branches Included

Here in the great shops of **Coyne** in Chicago, you're trained in everything from basic principles and Radio construction and Radio Servicing to F.M. (frequency modulation), public address systems, television and radio-phonographs. You can even get valuable **added training in Electric Refrigeration** for still more opportunities in the years ahead. **Coyne** gives "all-around" training! **48 years of success.**

Work on Real Equipment

You work on real actual equipment and expert instructors give you necessary theory in blackboard lectures and demonstrations. **In a few WEEKS you're ready for a real future!**

Starting Your Own Radio Shop

Want to be your own boss, with a fine-paying radio shop of your own? We show you how to set one up and operate it successfully. Hundreds of **Coyne** graduates are doing it. **You can, too.** Send **now** for details.

Get the Facts—FREE!

Our new giant Radio Opportunity Book has dozens of shop pictures, facts about Radio and Television jobs, our plans to help you. Rush coupon today. No obligation; no salesman will call. You alone will decide. But don't delay. Act NOW.

B. W. Cooke

Send for Details on Our STUDENT FINANCE PLAN

If you don't have much cash, we'll arrange to finance most of your tuition and you can pay it back in easy monthly installments after you graduate. We'll even help you get a part-time job if you wish, so you can EARN WHILE LEARNING. Our LIFETIME EMPLOYMENT SERVICE is free to **Coyne** Graduates. **Coyne** Training is the finest investment you can make.

MEN WITH PHYSICAL DISABILITIES

ANY MAN WITH A PHYSICAL DISABILITY whether a Veteran or not may qualify for **Coyne** training at no cost to them for tuition or subsistence. Check coupon for details.

THE HOME OF COYNE

VETERANS!
Coyne is also equipped to train those who qualify for training under the G. I. Bill of Rights. Check the coupon for special G. I. Bulletin.

B. W. COOKE, Director **Founded 1899**

COYNE ELECTRICAL SCHOOL
RADIO DIVISION

500 So. Paulina Street, Dept. 37-1K, CHICAGO 12, ILLINOIS

B. W. Cooke, Director Radio Div.,
COYNE ELECTRICAL SCHOOL,
500 S. Paulina St., Dept. 37-1K
Chicago 12, Ill.

I want to build a REAL FUTURE for myself. Send your big FREE BOOK on Radio, also details of your Student Finance Plan. Check if you are interested in information on the following:

☐ Send special G. I. Bulletin
☐ Send details on Physical Disability

NAME.....

ADDRESS.....

CITY.....STATE.....

easy-to-read tabular form the tube type, description, ratings, circuit applications and typical operation and characteristics of over fifty miniature tube types. Basing diagrams are also included on this single chart.

A copy of this guide may be secured by writing *Hytron Radio and Electronics Corporation*, Salem, Massachusetts.

MULTI-ANALYST

Details of the company's new "Multi-Analyst" are contained in a four-page bulletin being distributed by *Electronic Instrument Co., Inc.* of Brooklyn, New York.

This test instrument, which is suitable for all types of radio servicing including AM, FM and television receivers, is completely described and its operation explained in this free bulletin.

Copies of this publication are available from *Electronic Instrument Co., Inc.*, 926 Clarkson Avenue, Brooklyn, 3, New York.

TECHNICAL BULLETINS

Division Lead Company of Chicago has announced the availability of four new technical bulletins covering two models of wire strippers, their rosin core solder and the company's line of rosin fluxes.

Details of the wire strippers are contained in Bulletins 1-A and 2-A, while the solder is described in Bulletin 3-A. Information about the fluxes is contained in the publication designated Bulletin 4-A.

Any or all of these bulletins is available to RADIO NEWS readers upon request to *Division Lead Company*, 836 West Kinzie Street, Chicago, 22, Illinois.

FM PROMOTION KIT

General Electric Company's Transmitter Division is currently distributing a new, complete promotion kit for FM stations to be used in the building of local audiences.

Bound in an easy-to-handle portfolio-type cover, the kit outlines proved methods of building audiences for new FM stations. Titled "How to Build an Audience for Your New FM Station," the package covers such subjects as promotion, programming, advertising, publicity, and personnel information.

Among the ready-to-use material is a complete set of spot announcements, window banners for radio-dealer tie-ins, newspaper advertisements and the first issue of a publicity clip sheet which will be published and distributed monthly as a continuing service to purchasers of *General Electric* FM transmitters.

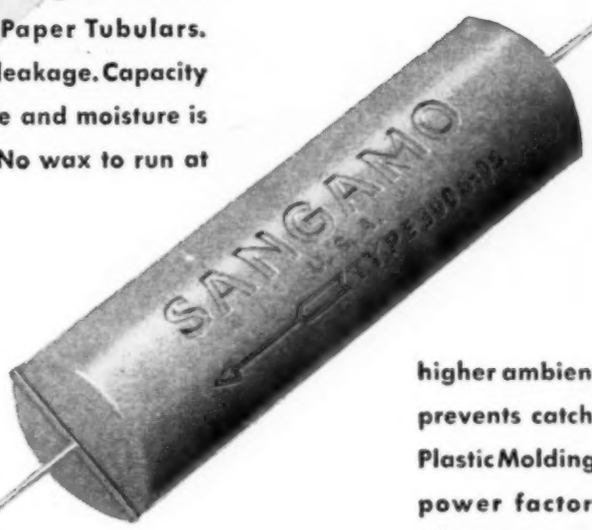
Prospective FM station owners and those already on the air with *GE* equipment should contact the Receiver Division, *General Electric Company*, Bridgeport, Conn. for their copy of this kit.

—30—

SANGAMO PAPER TUBULAR CAPACITORS ARE NOW MOLDED in PLASTIC

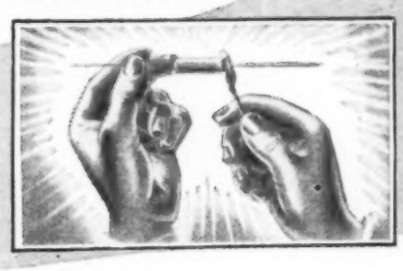
...just like micas!

Paper Tubular Capacitors, molded in Thermo-Setting Plastic! Designed for use in all circuits calling for Paper Tubulars. Plastic Molding means no leakage. Capacity values remain more stable and moisture is completely sealed out. No wax to run at higher ambient temperatures. Smooth finish prevents catching dirt and dust. All in all, Plastic Molding assures longer life and lower power factor. Specify Sangamo Plastic Molded Capacitors wherever you use Paper Tubulars.

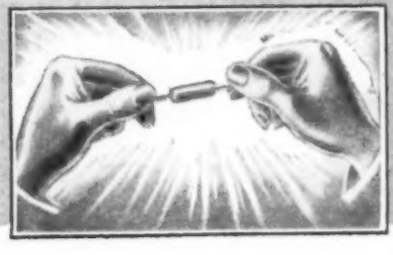


...try these tests WITH SANGAMO PLASTIC TUBULARS ....

WRITE NOW for the New Sangamo Capacitor Catalog for full information on the Sangamo Line.



NO WAX TO MELT....even heat as intense as is encountered in soldering, will not cause leakage in the case or at the lead joint.



LEADS WILL NOT PULL OUT...Plastic Molding so tightly seals the leads in place, that under all conditions of normal use, leads will stay put.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

Around the Clock

(*Continued from page 56*)

EST	LOCATION	CALL	FREQ.*
	Br. Guiana (Caribbean News Bulletin)		
12:00 noon	Quarry Heights, Canal Zone	AFRS	2.390
12:00 noon	Moscow (To Britain)	Radio Centre	9.610
			9.740
			15.360
			11.630
12:00 noon	New York	WCBN	15.270
		WCBX	17.830
		WCRC	21.570
	Schenectady	WGEO	15.330
	Boston	WRUL	15.290
		WRUW	17.750
	Via Munich, Germany		6.100
			6.170
			7.290
12:00 noon	Munich (Frankfurt), Germany	AFN	6.080
12:15 p.m.	Hamburg, Germany	BFN	7.290
12:30 p.m.	Omdurman,	Radio	13.320
(Thurs. *only*)	Anglo-Egyptian	Omdurman Sudan	9.650I
12:30 p.m.	Johannesburg,		6.095
(except Sun.)	So. Africa		3.450
12:40 p.m.	Stockholm	SBT	15.155
		SDB-2	10.780
		SBP	11.705I
12:45 p.m.	Ankara, Turkey	TAP	9.465
1:00 p.m.	Nairobi, Kenya (BBC)	VQ7LO	4.950
			6.060
1:00 p.m.	Hamburg, Germany	BFN	7.290
1:00 p.m.	Accra, Gold Coast (BBC)	ZOY	4.915
1:00 p.m.	Salzburg, Austria (AFRS)	KOFA	7.220
1:00 p.m.	London (GOS, Twenty-Four Hour News, followed by Home News from Britain at 1:10 p.m.)	GVR	21.675
		GWG	15.110
		GSP	15.310
		GVX	11.930
		GSO	15.180
		GRF	12.095
		GSF	15.140
		GRH	9.825
		GSD	11.750
		GVS	21.700
		GVZ	9.640
1:00 p.m.	London (AS)	GSI	15.260
		GVW	11.700
		GRY	9.600
		GSN	11.820
1:00 p.m.	Montreal, Que.	CFCX	6.005
1:15 p.m.	Vatican	HVJ	9.660
			5.970V
			15.095I
1:25 p.m.	Nairobi, Kenya	VQ7LO	4.950
			6.060
1:30 p.m.	Winnipeg, Manitoba	CKRX	11.720
1:45 p.m.	Brazzaville	FZI	9.440
			11.970
			17.530VI
1:50 p.m.	Milan (Originating in Rome)	Radio Italiana	11.810
			9.630
2:00 p.m.	Cincinnati	WLWR1	15.250
		WLWO	15.350
		WLWR	17.800
2:15 p.m.	Montreal, Quebec (To Europe)	CKCS	15.320
		CHOL	11.720
2:20 p.m.	Bern (To North	HEI7	15.325V
(except Sat.)	America)		
2:30 p.m.	London (AS, Radio Newsreel)	GVW	11.700
		GRY	9.600
		GSN	11.820
2:45 p.m.	Montreal, Quebec (To Europe, Canadian Commentary)	CKCS	15.320
		CHOL	11.720
2:55 p.m.	Lourenco Marques, Mozambique	CR7AA	5.860
		CR7BJ	9.645I
		CR7AB	3.493
		CR7BD	15.230
3:00 p.m.	Capetown, So. Africa(SABC)		5.877V
(except Fri.)	Johannesburg (SABC)		6.095
			3.450
3:00 p.m.	Hamburg, Germany	BFN	7.290
3:00 p.m. (Sun. 3:35 p.m.)	Madrid	RNE	9.369
3:00 p.m.	London (GOS)	GWG	15.110
		GRF	12.095
		GSB	9.510
		GWA	6.125
		GRH	9.825
		GSD	11.750
		GRW	6.150
		GVZ	9.640
		GSO	15.180
3:00 p.m.	Georgetown, Br. Guiana (BBC)	ZFY	6.000
3:00 p.m.	Halifax, Nova Scotia	CHNX	6.130
3:30 p.m.	Sofia, Bulgaria	Radio Sofia	9.350
			7.670
3:30 p.m.	Belgrade, Yugoslavia	Radio Belgrade	6.100V
3:30 p.m.	Prague	OLR2A	6.010
3:45 p.m.	London (AS)	GVW	11.700
		GRY	9.600
		GSN	11.820
3:45 p.m.	Brazzaville	FZI	9.440
			11.970
			17.530V
3:45 p.m.	Munich, Germany		6.100
			6.170
			7.290
3:45 p.m.	Capetown, So. Africa (BBC)		5.877V
	Johannesburg (BBC)		6.095
			3.450
3:50 p.m.	Bern	HER5	11.865
3:50 p.m.	Warsaw	Polskie Radio	6.115V
4:00 p.m.	United Network, U.S.A.	KNBA	21.610
		KCBF	17.850
		KWID	17.760
		KNBX	15.340
		KCBA	15.240
4:00 p.m.	Melbourne (To Britain, Europe)	VLA4	11.770
4:00 p.m.	London (GOS, Radio Newsreel)	GRF	12.095
		GWA	6.125
		GVZ	9.640
		GRW	6.150
		GVY	11.955
4:15 p.m.	New York	WCBX	9.490
		WCRC	11.830
	Schenectady	WGEO	15.330
	Boston	WRUL	15.290
		WRUW	11.730
4:30 p.m.	Ankara,	TAP	9.465
(Mon., Thurs. to Britain; Sun., Postbag)	Turkey (Talk)		
4:30 p.m.	London (European Service)	GSW	7.230
		GWL	7.210
		GRO	6.180
		GRG	11.680
4:45 p.m.	Montreal, Quebec (To Europe)	CHOL	11.720
		CKLO	9.630
4:45 p.m.	London (NAS)	GWH	11.800
		GSC	9.580
		GRH	9.825
4:45 p.m.	Melbourne (To Forces)	VLB6	15.200
		VLC1O	21.680
	(To Britain, Europe)	VLA4	11.770
5:00 p.m.	Los Angeles (AFRS)	KGEI	15.130
		KGEX	15.210
	Via Honolulu	KRHO	17.800
5:00 p.m.	United Network, U.S.A.	KNBA	21.610
		KCBF	17.850
		KWID	17.760
		KNBX	15.340
		WBOS	15.250
		KCBA	15.240
5:00 p.m.	Hamburg, Germany	BFN	7.290
5:00 p.m.	Moscow (To Britain)	Radio Centre	6.160
			7.300
			7.330
			9.680
	Via Kiev		6.020
5:00 p.m.	Halifax, Nova Scotia	CHNX	6.130
5:00 p.m.	Munich (Frankfurt, Germany	AFN	6.080
5:00 p.m.	Salzburg, Austria (AFRS)	KOFA	7.220
5:00 p.m.	Quito, Ecuador (Relayed from United Network, U.S.A.)	HCJB	12.455
			15.115
			9.958
5:05 p.m.	Los Angeles (AFRS, At Dictation Speed)	KGEI	15.130
		KGEX	15.210
	Via Honolulu	KRHO	17.800
5:15 p.m.	Brazzaville (To Britain)	FZI	9.440
			11.970
			9.984
			6.024
5:15 p.m.	Kingston, Jamaica (World News)	ZQI	4.700
5:30 p.m.	Halifax, Nova Scotia	CHNX	6.130
5:30 p.m.	St. John's Newfoundland	VONH	5.970
5:30 p.m.	Edmonton, Alberta	VE9A1	9.540
5:30 p.m.	London (European Service)	GSA	6.050
		GRJ	7.320
6:00 p.m.	London (GOS)	GSB	9.510
		GSD	11.750
		GVY	11.955
	Via Georgetown, Br. Guiana	ZFY	6.000
6:00 p.m.	Los Angeles (AFRS)	KNBA	21.610
		KNBI	17.770
		KCBR	15.330

(*Continued on page 112*)

TELEVISION-

Does it Hold A Future For You?

SPECIAL INVITATION TO WAR VETERANS

With extensive new training facilities under the personal supervision of the famed inventor of the radio vacuum tube, Dr. Lee de Forest, we are able to accept additional applications from Veterans for Television training under the G.I. Bill of Rights. For qualified men who are seriously considering entering a residence school, we have a limited number of Home Study Courses which are available free of charge. Your success with this course will not only help you to decide your own future in Television but will also aid us greatly in qualifying you for residence training.

Send your name and address for your Eligibility Questionnaire. If you qualify under the simple rules, you may start your Home Study Television Course at once and entirely without cost or obligation to you.

American Television Laboratories, Inc.

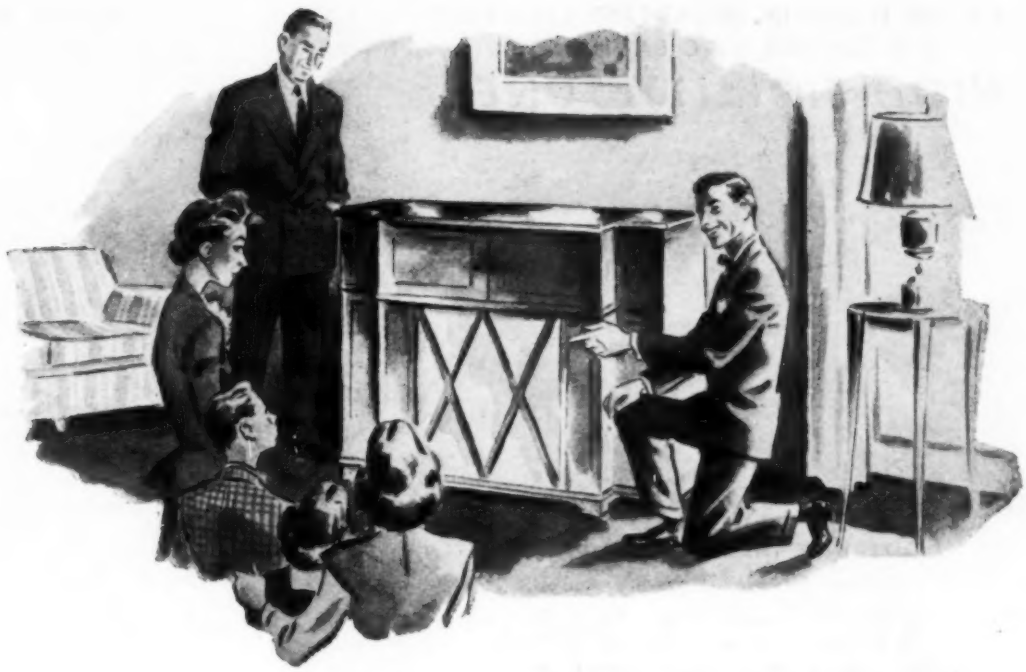
5050 BROADWAY · CHICAGO 40, ILLINOIS

EST	LOCATION	CALL	FREQ.*
		KWIX	15.290
		KGEI	15.130
		KGEX	15.210
	Via Honolulu	KRHO	17.800
6:00 p.m.	United Network, U.S.A.	KCBF	17.850
		KWID	17.760
		KNBX	15.340
		WBOS	15.250
		KCBA	15.240
6:00 p.m.	Salzburg, Austria (AFRS)	KOFA	7.220
6:00 p.m.	Quarry Heights, Canal Zone	AFRS	2.390
6:00 p.m.	Halifax, Nova Scotia	CHNX	6.130
6:25 p.m. (except Sun.)	Kingston, Jamaica (Headlines)	ZQI	4.700
6:25 p.m.	Moscow (To North America)	Radio Centre	11.890V
			9.480
			7.240V
			7.300
			7.360
	Via Komsomolsk		15.230
	Via Kiev		6.020
6:30 p.m.	Montreal, Quebec (To Latin America)	CKRZ	6.060
		CKRA	11.760
6:30 p.m.	Sydney, Nova Scotia	CJCX	6.010
6:30 p.m.	Toronto, Ontario	CFRX	6.070
6:30 p.m. (irreg.)	St. John's Newfoundland (Messages)	VONH	5.970
6:45 p.m.	London (NAS)	GWH	11.800
		GSC	9.580
		GRH	9.825
7:00 p.m.	Brazzaville (To North America)	FZI	9.440
			11.970
			9.984
7:00 p.m.	London (GOS, Radio Newsreel)	GSB	9.510
		GSD	11.750
		GVY	11.955
		GRW	6.150
7:00 p.m.	Los Angeles (AFRS)	KNBA	21.610
		KNBI	17.770
		KCBR	15.330
		KWIX	15.290
	Via Honolulu	KRHO	17.800
7:00 p.m.	United Network, U.S.A.	KCBF	17.850
		KWID	17.760
		KNBX	15.340
		WBOS	15.250
		KCBA	15.240
		WLWO	11.790
		WRUW	9.550
7:00 p.m.	Melbourne (To East U.S. and Canada)	VLA9	21.600
7:00 p.m.	Moscow (To North America, Moscow Newsreel)	Radio Centre	11.890V
			9.480
			7.240V
			7.300
			7.360
	Via Komsomolsk		15.230
	Via Kiev		6.020
7:08 p.m. (irreg.)	Prague (to North America)	OLR5A	15.230
7:15 p.m. (or 7:25 p.m.)	Helsinki (Lahti), Finland (To North America)	OIX2	9.505V
		OIX4	15.190
7:15 p.m.	Leopoldville (To North America)	OTC2	9.745V
7:15 p.m.	Georgetown, Br. Guiana (Caribbean News Bulletin)	ZFY	6.000
7:30 p.m.	Winnipeg, Manitoba	CKRX	11.720
7:30 p.m.	Moscow (To North America)	Radio Centre	7.300
			7.240V
			9.480
	Via Kiev		6.020
7:30 p.m.	London (NAS, Radio Newsreel)	GWH	11.800
		GSC	9.580
		GRH	9.825
		GSL	6.110
8:00 p.m.	Los Angeles (AFRS)	KNBA	21.610
		KNBI	17.770
		KCBR	15.330
		KWIX	15.290
	Via Honolulu	KRHO	17.800
8:00 p.m.	United Network, U.S.A.	KCBF	17.850
		KNBX	15.340
		WBOS	15.250
		KCBA	15.240
		WLWO	11.790
		KWID	9.570
		WRUW	9.550
8:00 p.m.	St. John's Newfoundland	VONH	5.970
8:00 p.m	Quarry Heights, Canal Zone	AFRS	2.390
8:00 p.m.	Moscow (To North America, Moscow Newsreel)	Radio Centre	7.300
			7.240V
			9.480
	Via Kiev		6.020
8:00 p.m.	Colombo, Ceylon (BBC)	Radio SEAC	5.120
			6.075
			7.185I
8:00 p.m.	London (NAS)	GWH	11.800
		GSC	9.580
		GRH	9.825
		GSL	6.110
8:00 p.m.	London (GOS, followed irreg. by Home News from Britain at 8:10 p.m.)	GSB	9.510
		GRW	6.150
		GSD	11.750
		GWA	6.125
8:00 p.m.	Georgetown, Br. Guiana (BBC)	ZFY	6.000
8:05 p.m.	Stockholm (To North America)	SBU	9.535
		SDB-2	10.780
8:10 p.m.	Leopoldville (To North America)	OTC2	9.745V
8:15 p.m.	Colon, Panama	HP5K	6.005
8:30 p.m.	Moscow (To North America)	Radio Centre	7.300
			7.240V
			9.480
	Via Kiev		6.020
8:30 p.m.	Rangoon, Burma (Headlines)	Radio Rangoon	9.543
8:45 p.m. (except Sat.)	Bern (To North America)	HER3	6.165I
		HEI4	9.539
		HER5	11.865I
9:00 p.m.	Honolulu (AFRS)	KRHO	17.800
9:00 p.m.	United Network, U.S.A.	KCBF	17.850
		KNBX	15.340
		WBOS	15.250
		KCBA	15.240
		KCBR	11.790
		KWID	9.570
9:00 p.m.	Colombo, Ceylon (BBC)	Radio Colombo	4.900
9:00 p.m.	Quarry Heights, Canal Zone	AFRS	2.390
9:00 p.m.	Edmonton, Alberta	VE9AI	9.540
9:00 p.m.	Paris (To North America)	RNF	9.550
			11.845V
			9.520I
9:00 p.m. (Sun. only?)	Kingston, Jamaica	ZQI	2.330
9:00 p.m.	St. John's, Newfoundland	VONH	5.970
9:00 p.m.	Sydney, Nova Scotia	CJCX	6.010
9:20 p.m. (irreg.)	St. John's Newfoundland	VONH	5.970
9:30 p.m.	Delhi	AIR	15.190
			7.290
			6.190
			9.670
			11.760
	Bombay		6.150
	Madras		6.085
	Calcutta		6.010
9:30 p.m.	London (GOS)	GSB	9.510
		GVY	11.955
10:00 p.m.	Colombo, Ceylon	Radio SEAC	15.120
			6.075
10:00 p.m.	Colon, Panama	HP5K	6.005
10:00 p.m.	Quarry Heights, Canal Zone	AFRS	2.390
10:00 p.m.	Honolulu (AFRS)	KRHO	17.800
10:00 p.m.	Sydney, Nova Scotia	CJCX	6.010
10:00 p.m.	Vancouver, B. C.	CBRX	6.160
10:00 p.m.	London (GOS, Twenty-Four Hour News)	GSB	9.510
		GSD	11.750
		GRW	6.150
		GSL	6.110
		GRH	9.825
		GWA	6.125
10:00 p.m.	Melbourne (To Forces)	VLG5	11.880
		VLC9	17.840
		VLA9	21.600
10:30 p.m.	Paris (To North America)	RNF	9.550
			11.845V
			9.520I
10:30 p.m.	Delhi	AIR	15.190
			21.510
			17.830
			15.160
			11.870
10:45 p.m.	Panama City	HOXA	15.100
11:00 p.m.	Honolulu (AFRS)	KRHO	17.800
11:00 p.m.	Quarry Heights, Canal Zone	AFRS	2.390
11:00 p.m.	London (GOS, followed by Home News from Britain at 11:05 p.m.)	GWA	6.125
		GRY	9.600
		GRX	9.690
		GSB	9.510
		GSD	11.750
		GWO	9.625
		GSN	11.820
11:00 p.m.	Colombo, Ceylon	Radio SEAC	15.120
			6.075
11:00 p.m.	Winnipeg, Manitoba	CKRO	6.150
11:15 p.m.	London (GOS, Radio Newsreel)	GWA	6.125
		GRX	9.690
		GSB	9.510
		GSD	11.750
		GWO	9.625

(Continued on page 114)

EST	LOCATION	CALL	FREQ.*
		GSN	11.820
		GRF	12.095
		GRN	6.195
		GRY	9.600
12 midnight	Honolulu (AFRS)	KRHO	17.800
12 midnight	Edmonton, Alberta	VE9A1	9.540
12 midnight	Vancouver, B.C.	CBRX	6.160
12 midnight	Munich (Frankfurt), Germany	AFN	6.080
12:15 a.m.	Melbourne (To West U.S.)	VLG7	15.160
		VLC4	15.320
		VLA4	11.770
		(or VLA8	11.760)
		VLB9	9.615
		(or VLB8	21.600)
	(To South Africa)	VLC9	17.840I
12:30 a.m.	Brazzaville (To West U.S., Australia, New Zealand)	FZI	11.970
			9.440
12:30 a.m.	Delhi	AIR	15.190
			15.160
			21.510
			11.870
			17.830
12:30 a.m.	Colombo, Ceylon	Radio	15.120
		SEAC	6.075
12:55 a.m.	Winnipeg, Manitoba (Night Final)	CKRO	6.150
1:00 a.m.	Singapore	Radio Malaya	7.220
1:00 a.m.	Capetown, So. Africa (BBC)		5.877V
	Johannesburg (BBC)		6.007
			6.095
			4.377
1:00 a.m.	Edmonton, Alberta	VE9AI	9.540
1:00 a.m.	Calgary, Alberta	CFVP	6.030
1:00 a.m.	Vancouver, B.C.	CBRX	6.160
1:00 a.m.	London (European Service)	GRO	6.180
1:00 a.m.	London (GOS)	GRF	12.095
		GWG	15.110
		GSD	11.750
		GST	21.550
		GSB	9.510
		GSF	15.140
		GWE	15.435
		GVQ	17.730
		GSO	15.180
		GRY	9.600
		GRH	9.825
		GWA	6.125
1:00 a.m.	London (PS)	GRX	9.690
		GSN	11.820
		GSP	15.310
		GVZ	9.640
		GRQ	18.025
1:00 a.m.	Melbourne (BBC)	VLR	9.540
1:30 a.m.	Delhi	AIR	15.190
			15.160
			21.510
			11.870
			17.830
			15.290
	Calcutta		9.530
1:30 a.m.	Rangoon, Burma	Radio Rangoon	6.035
1:30 a.m.	London (PS, Radio Newsreel)	GRX	9.690
		GSN	11.820
		GSP	15.310
		GVZ	9.640
		GRQ	18.025
1:30 a.m.	Colombo, Ceylon	Radio SEAC	15.120 6.075
2:00 a.m.	Edmonton, Alberta	VE9AI	9.540
2:00 a.m.	Hamburg, Germany	BFN	7.290
2:00 a.m.	London (GOS, At Dictation Speed)	GRF	12.095
		GWG	15.110
		GVT	21.790
		GSD	11.750
		GST	21.550
		GSB	9.510
		GSF	15.140
		GVQ	17.730
		GSO	15.180
		GSV	17.810
		GRH	9.825
		GWA	6.125
2:15 a.m.	London (European Service)	GSA	6.050
		GRO	6.180
		GWN	7.280
		GRI	9.410
		GWO	9.625
		GSE	11.860
2:30 a.m.	Melbourne (To Britain)	VLA9	21.600
		VLB3	11.770
		(Except Sat.)	
		VLA4	11.770
		(Sat. only)	
		VLC10	21.680
		(Sat. only)	
2:45 a.m.	Colombo, Ceylon	Radio Colombo	4.900
2:45 a.m.	Vancouver, B. C.	CBRX	6.160
3:00 a.m.	Colombo, Ceylon (BBC)	Radio SEAC	15.120 6.075
3:00 a.m.	Perth (BBC)	VLW3	11.830
3:00 a.m.	Delhi	AIR	9.590
			17.760
			9.670
			15.190
			15.290
	Bombay		9.630
	Madras		9.585
3:00 a.m.	London (GOS)	GWG	15.110
3:00 a.m.	London (PS)	GRX	9.690
		GRQ	18.025
		GRD	15.450
		GSN	11.820
		GSP	15.310
		GVS	21.710
		GVZ	9.640
3:15 a.m.	Salzburg, Austria (AFRS)	KOFA	7.220
3:45 a.m.	Singapore	Radio Malaya	15.300 15.275
			11.735V
			6.770
4:00 a.m.	Komsomolsk, U.S.S.R.		9.565V
4:00 a.m.	Honolulu (AFRS)	KRHO	9.650
4:00 a.m.	Melbourne (To Forces)	VLB8	21.600
		VLA6	15.200
		VLC4	15.320
		VLG10	11.760
4:00 a.m.	Melbourne (A.B.C.)	VLR2	6.150
		VLH3	9.580
4:00 a.m.	Brisbane (A.B.C.)	VLQ2	7.215
4:00 a.m.	Tokyo (AFRS)	JLR	6.015
			4.880V
4:30 a.m. (or 5:00 a.m.)	Delhi	AIR	21.510
			15.160
			15.290
			11.870
5:00 a.m.	Saigon, Fr. Indo-China	Radio Saigon	11.780 4.810
5:00 a.m.	Shanghai	XORA	11.695V
5:00 a.m.	Los Angeles (AFRS)	KNBA	9.490
		KNBI	6.060
		KNBX	11.790
		KCBR	9.700
		KGEX	11.730
	Via Honolulu	KRHO	9.650
5:30 a.m.	Manila	KZRH	9.640
5:45 a.m. (irreg.)	Djokjakarta (?), Java		12.002V
6:00 a.m.	Los Angeles (AFRS)	KGEI	9.530
		KCBA/F	9.750
6:00 a.m.	New York	WNRA	18.160
		WNRE	15.280
		WNBI	17.750
		WOOW	11.810
	Boston	WRUA	15.130
		WBOS	15.210
6:00 a.m.	London (GOS, followed by Home News from Britain at 6:10 a.m.)	GSG	17.790
		GSN	11.820
		GSV	17.810
		GSJ	21.530
		GSH	21.470
		GRF	12.095
		GSO	15.180
		GSD	11.750
		GSI	15.260
6:00 a.m.	Georgetown, Br. Guiana (BBC)	ZFY	6.000
6:00 a.m.	Colombo, Ceylon (BBC)	Radio SEAC	15.120 6.075
6:00 a.m. (irreg.)	Shanghai	XORA	11.695V
6:00 a.m.	Toronto, Ontario	CFRX	6.070
6:00 a.m.	Hong Kong (BBC)	ZBW	9.540V
6:00 a.m.	Melbourne (To Forces)	VLB8	21.600
		VLA6	15.200
6:00 a.m.	Melbourne (A.B.C.)	VLR2	6.150
		VLH3	9.580
6:00 a.m.	Brisbane (A.B.C.)	VLQ2	7.215
6:00 a.m.	Perth (A.B.C.)	VLW7	9.520
6:00 a.m. (irreg.)	Hanoi, Fr. Indo-China	Radio Viet Nam	9.660V
6:10 a.m.	Melbourne (To Forces)	VLB8	21.600
		VLA6	15.200
6:15 a.m. (irreg., may be 5:15 a.m. now)	Bangkok, Siam	HS8PD	5.990V
6:15 a.m.	Capetown, So. Africa		9.608
	Johannesburg		9.912
			4.377
6:30 a.m.	Teheran, Iran	EQB	6.155
		EPB	15.100
6:30 a.m.	Delhi (To Africa and East Indies)	AIR	17.830
			15.190
			21.510
			11.870
	Calcutta		6.010
6:30 a.m.	Singapore	Radio Malaya	15.300 15.275
			11.735V
			6.770
6:30 a.m.	China (Shanghai or Yenang?)	XMTA	12.215V
6:45 a.m.	London (FES)	GVP	17.700
		GRZ	21.640
		GRH	9.825

—30—



Try This!

Call those of your customers who own fine radios—*people to whom you have sold radios or homes in which you have serviced radios.* Tell them you have a speaker that will make their old sets sound as fine as any brilliant 1947 model. Arrange to demonstrate this Altec Lansing speaker* in their homes. Suggest that they invite neighbors and friends to witness the amazing demonstration. The Altec Lansing Dia-Cone will so greatly improve tone quality and performance that further sales talk will be unnecessary.

Model 600 Dia-Cone

12-inch speaker

*Designed for installation in those fine sets where ultra-high fidelity sound reproduction is desired. This speaker employs the exclusive Dia-Cone principle, reproducing high and low frequencies from separate diaphragms.

ASK YOUR JOBBER ABOUT AVAILABILITY OF THIS SPEAKER.

ALTEC
LANSING CORPORATION
1161 N. Vine St., Hollywood 38, Cal.
250 W. 57th St., N. Y. 19, N. Y.

"KEEP ADVANCING WITH ALTEC LANSING"

Farm Markets

(*Continued from page* 62)

An indication as to the possible consumption of electricity on farms might be found in Benton County, Iowa. This relatively prosperous county has had power-line service to a large percentage of its farms for several years. The monthly consumption of rural electricity users in that county is 462 kilowatt hours each. And even in this county, users indicate that they are not using as many appliances as they would like, or will be using once equipment becomes available. Many Benton County farm homemakers, for example, are anxiously awaiting the day when they can replace the old cob burner in the kitchen with a fancy new electric range.

In spite of the most optimistic estimates of possible farm consumption, many farmers now find their original wiring installations are already falling far short of carrying the load—both in the home and around the farm buildings. Right now, thousands of farmers are having their service installations revamped—heavier wire, more circuits, more power outlets. They find needs for electric power that they never dreamed of when electricity first came to their farms.

Then they were thinking of electric lights, a few small motors, and household gadgets—maybe even an electric refrigerator. Nowdays, they're thinking about large motors on the elevator and feed grinder, a milk cooler, welding equipment, ventilating systems and artificial drying for hay and grain crops. And the good woman is thinking about electric ranges, automatic water heaters and freezer-storage cabinets.

If the figures of the Iowa survey are

(*Continued on page* 120)

DIAL POINTER ON PORTABLE RADIO

SOME portable radios do not have a dial lamp and use a white line on a disk behind a translucent dial face.

This white line fades out in time—making station identification difficult.

A narrow strip of white adhesive tape placed in the position of the original white line is easy to see and makes dialing easy. . . . . H. L.

LET THESE WAA DISTRIBUTORS HELP YOU

Save with surplus

The War Assets Administration has appointed a representative group of competent well established distributors to help dispose of war-surplus electronic tubes and equipment. We suggest that you get in touch with the distributor nearest you. He will know the items available and how they can aid in solving your electronic problems.

ELECTRONICS DIVISION
OFFICE OF AIRCRAFT DISPOSAL

WAR ASSETS ADMINISTRATION

425 Second St., N.W. Washington 25, D. C.

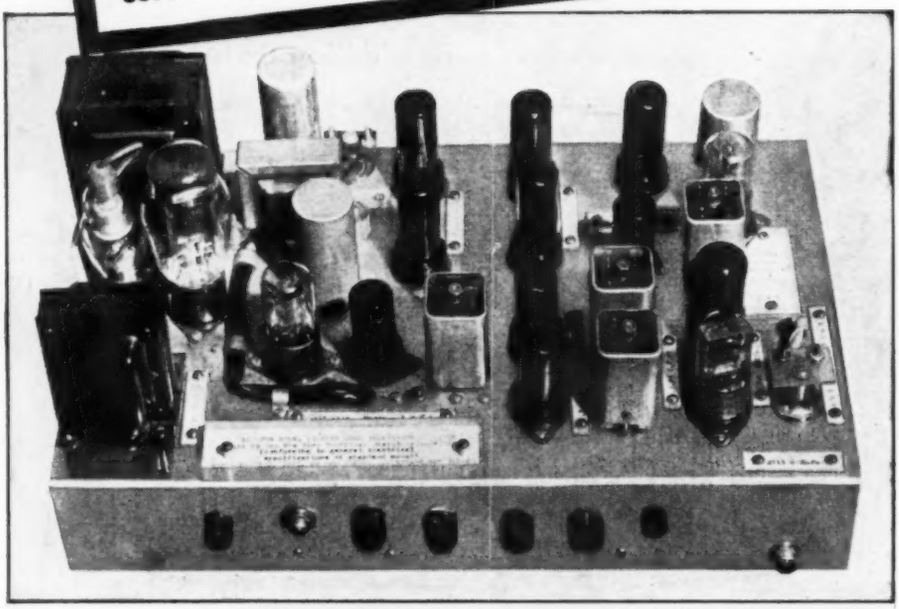
Here is an up-to-date list of WAA approved distributors.

BOSTON, MASS.	
Automatic Radio Mfg. Co., Inc.	122 Brookline Ave.
Technical Apparatus Co.	165 Washington St.
BUCHANAN, MICH.	
Electro-Voice, Inc.	Carroll & Cecil Sts.
CANTON, MASS.	
Tobe Deutschmann Corp.	863 Washington St.
CHICAGO, ILL.	
American Condenser Co.	4410 Ravenswood Ave.
Majestic Radio & Television Corp.	125 W. Ohio St.
EMPORIUM, PENN.	
Sylvania Electric Products, Inc.	
FORT WAYNE, IND.	
Essex Wire Corp.	1601 Wall St.
LOS ANGELES, CALIF.	
Cole Instrument Co.	1320 S. Grand Ave.
Hoffman Radio Corp.	3761 S. Hill St.
NEWARK, N. J.	
Standard Arcturus Corp.	99 Sussex Ave.
Tung-Sol Lamp Works, Inc.	95—8th Ave.
NEW YORK, N. Y.	
Communication Measurements Laboratory	120 Greenwich St.
Electronic Corp. of America	353 W. 48th St.
Emerson Radio & Phonograph Corp.	76—9th Ave.
Hammarlund Mfg. Co., Inc.	460 W. 34th St.
Newark Electric Co., Inc.	242 W. 55th St.
Raytheon Mfg. Co.	60 E. 42nd St.
Smith-Meeker Engineering Co.	125 Barclay St.
SALEM, MASS.	
Hytron Radio & Electronics Corp.	76 LaFayette St.
SCHENECTADY, N. Y.	
General Electric Co	Bldg. 267, 1 River Rd.
WASECA, MINN.	
E. F. Johnson Co.	206—2nd Ave., S. W.

916

Build a TELEVISION

To stimulate its radio and television training programs, this famous resident radio and television school is offering men interested in television this unusual opportunity.



You can build a direct viewing television chassis similar to the one pictured above, complete with all tubes, including speaker and 7-inch picture tube right in your own home by following carefully the exact instructions sent to you by this famous television school, located square in the HEART of America's television manufacturing and broadcasting industry. Mail the coupon on the next page to get full details.

Here is a typical scene showing an instructor checking the construction completed by the two students in the background.

IF you are unable to leave home to go to a resident school, N.Y.T.I. of N.J. can supply you with all the parts to build a television chassis in your own home. You will be supplied with exactly the same instructions and directions with which the school's resident students are equipped, when they reach the stage in their training that calls for television set construction. If you already have a sound radio background, with experience in building radio receivers, you will be surprised to find how much you can learn about television by studying the directions, and building this set.

N.Y.T.I. of N.J. is one of America's leading resident schools in television for men seeking dependable, thorough, up-to-the-minute training in the various fields of radio and television.

The schooling offered by N.Y.T.I. of N.J. is particularly useful to those who recognize the high-earning possibilities of technical training in radio and television and are willing to tackle the class and laboratory work offered.

A grammar school education definitely is required. Moreover, N.Y.T.I. of N.J. requires that a student be earnest, sincere and radio-minded. Students without proper mathematical backgrounds are taught the radio and television mathematics and theory they need.

A considerable number of out-of-

Bob Cohen, shown checking the television set he has built, to make sure there are no engineering inaccuracies.

MAIL THE COUPON TO GET FULL

SET *Right in Your Own Home!*

Instructor demonstrating theory of light in connection with study of optical systems used in projection type television receivers.

state students attend the school because of its excellent, practical type of radio and television courses, so difficult to get anywhere else. Living quarters are obtainable by single students. Married students are requested not to bring their families until they can find suitable accommodations for them.

You Put Into Practice Everything You Learn

Students at N.Y.T.I. of N.J. particularly like the way the school puts into practice what it teaches. You may actually build a 17-tube television chassis. You also help build as many as 7 radio receivers of different types, a total of 75 electronic educational devices. Class study and laboratory study, in the proper combination, increase interest—and your hands get as smart as your head.

A 17-tube, experimental, television chassis may be built by all resident students of television, and may be kept as their own property, if they so choose.

Located in the Heart of the Radio, Electronic and Television Industry

The New York Technical Institute of New Jersey is in Newark, N. J., just across the river from New York City (only 20 minutes from Broadway by subway or train). The school is located in the heart of America's great radio and television industry. Such leading television, radio and electronics manufacturers as R.C.A., Western Electric, DuMont, Federal, Westinghouse and Edison are nearby. This means that the school offers numerous advantages, as it is in touch with the most recent developments.

Highly qualified television and radio instructors are here in abundance. Equipment is easier to get. Television students are offered exceptional advantages in this great electronic center.

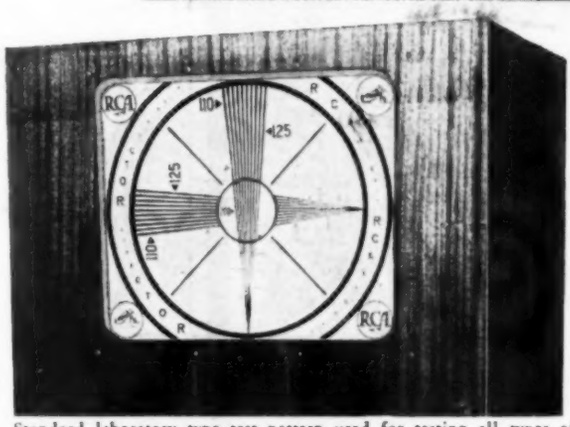
Coupon Brings Full Information—FREE

The school issues a special Bulletin which illustrates and describes its truly exceptional laboratory facilities and equipment. This Bulletin also describes classes that may be attended, housing conditions, costs, hours, etc. If you are interested in Television—you will want to read this Bulletin. You can have it *free,* merely by mailing the coupon at right.

The school will also be happy to send you complete information about the television kits and directions which are now available to you if you desire to build your own television chassis at home.

Just fill out the coupon at right and mail it NOW to: *New York Technical Institute of New Jersey, Dept. 1B, 158 Market Street, Newark, N. J.*

Big picture television, 16"x21¼", "in the flesh" at N.Y.T.I. of N.J. All types of television receivers are available for student use and instruction in the resident school.



Standard laboratory type test pattern used for testing all types of television transmitters and receivers. (You can see it at N.Y.T.I. of N.J.)

New York Technical Institute of New Jersey, Dept. 1B
158 Market Street, Newark, New Jersey

☐ Check here if you wish to receive the Special FREE Bulletin describing the resident school of the New York Technical Institute of New Jersey located in Newark, N. J.—including its facilities, equipment, courses offered, costs, hours, etc.

☐ Check here if you wish complete information about building a television chassis in your own home.

☐ Check here if you are a War Veteran.

Name ..... *Age* .....

Address .....

City ..... *Zone (if any)* ..... *State* .....

(N.Y.T.I. of N.J. employs no salesmen to call.)

INFORMATION *Free*

any indication, there's a billion dollar business waiting for radio and appliance dealers in that one state alone. And, incidentally, those figures should be fairly reliable as an indication of farmers' buying intentions. They were carefully checked by the Statistical Laboratory at Iowa State College which operates in cooperation with the Bureau of Agricultural Economics. To that billion dollars add the potential business from 47 other states and what it adds up to is not peanuts! Then there is normal replacement business to think about.

Four electrical appliances far outshadow all others in terms of popularity, the Iowa survey shows. When the juice is turned on the first things the family buys are a radio and a washing machine, an iron and an electric refrigerator.

A radio is No. 1 in popularity. In Iowa 96% of all farm families with electricity have radios. Some families have more than one receiver and a radio in the dairy barn is not uncommon. About 14% of the families said they intend to purchase new radios soon. While you occasionally see a swanky console model receiver in farm homes—most of them can be classed in the low priced bracket.

An electric washer is more popular even than an electric iron. More than 94% of the farm families surveyed have electric washers. Many of these are older machines which have been converted to electric power by the replacement of the gasoline motor with a quarter-horse electric job. Today one farm family out of every 10 which has highline power is in the market for a new washer.

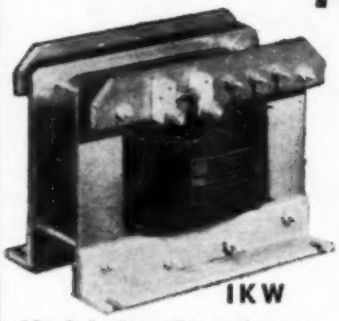
However nearly all farm homemakers have an electric iron to go with their washer—87.6% of all electrified farm homes. Here again, more than one farm housewife out of every 10 wants a new iron. Chances are she has the nickels and dimes stored away for its purchase—in the teapot on the top cupboard shelf.

The first really good sized cash layout for electrical equipment goes for a refrigerator. Over two-thirds of the families with current available have refrigerators. The other 29.5% are going to buy them as fast as they come off the assembly lines. Refrigerators for farm families run a little larger in size than those the average city dweller buys. A 9-cubic foot box is not uncommon. Most folks, however, wish they had purchased a larger refrigerator than they did. Shopping for groceries is largely a once-a-week job for the average farm housewife. So the refrigerator should be large enough to store a week's supply of perishables. There are more mouths to feed and it takes more to fill them up.

Home-freezer-lockers? Probably the sale of this much talked and promoted postwar dream will come a little slower than most manufacturers realize. Nearly every farm family would like to have one, it's true. But there are so many other things that they would like to have that the freezer storage case will have to wait for a while. Furthermore, farm families being rather shrewd and sometimes conservative—would just as soon have their city cousins try them out first. The cost—both initial and operational—looks a little high to a lot of folks, too. In Iowa about one farm home in 200 now has a home locker and about one family in 15 indicated they hope to purchase one. One appliance dealer in eastern Iowa kept a list of people who made inquiries for lockers during the war years. He had 125 people on that

Charles Golenpaul of Aerovox, Sam Poncher of Newark Electric, and Margaret McGowan of the Show Staff draw the slips which assigned 158 manufacturers' booths and the 10 half-booths which will be used in the exhibition hall at the Radio Parts and Electronic Equipment Show to be held at Hotel Stevens in Chicago, May 11th to 16th.

SAVE! ON THESE AND THOUSANDS OF OTHER BARGAINS IN STOCK FOR IMMEDIATE DELIVERY



1KW

Modulation Transformer

SPECIALLY PRICED AT **$14.95**

We have a real value in a modulation transformer. This item, made by RCA TO BROADCAST SPECIFICATIONS, is conservatively rated at 550 Watt audio to modulate that new KW rig. Really rugged construction with protective flashover gaps which are adjustable. Terminals and taps are mounted on a "Mycalex" terminal board. The laminations that make up this transformer are of high audio quality and are extremely thin, making it impossible for the core to "chatter or talk." Audio Watts—550 Sec. #1—450 Mils Sec. #2—80 Mils Turns Ratio—Pri: Sec. #1-1:1 Pri: Sec. #2-5:1 Pri: Sec. #2 Tap-25:1 Impedance Ratio—Pri: #1-1:1 Sec. Pri: Sec #2-25:1 Pri: Sec #2 Tap-625:1 DC Resistance—Pri., 135 ohms Sec: #1 112 ohms; Sec. #2 90 ohms Transformers insulation tested: Pri. 8000V.; Sec. #1-11-000V; Sec. #2-2000V. to the rest of the coils and core. Primary center-tapped for Class "B" modulators. Secondary #2 will carry 80 Mils to modulate screens of beam power or screen grid tubes. Primary will match any Class "B" tubes up to 10,000 ohms plate to plate, such as 810's, 75T's, 809S's, ZB120's, 203's, HY51Z's, 211's, 813's, 828's, 805's 2832's. Size 9½" wide, 7½" deep, 7½" high. Heavy channel iron mounting brackets. Weight approx. 40 lbs.—Cat. No. MT-100

Something You Can't Be Without

PIN STRAIGHTENER

For miniature tubes—Gov't cost $4.80 our price—Cat. No. PIO **49c**

MICA CAPACITATOR

Mica capacitator .002 MFD 3000 WVDC Cat. No. RT-101 **49c**

IF TRANSFORMER

IF transformer, mounted in aluminum shield can, 1500 KC, with air trimmer, impedance coupled type—Cat. No. T-15 **95c**

30MC IF TRANSFORMER

30 MC IF transformer in square aluminum can, silver slugged tuned—Cat. No. T-20. **29c**

Butterfly Condensers

Ideal for high frequency work.

Type A—frequency range 75 to 300 megacycles to be used with 955 tubes. Cat. No. BC-1

Type B—frequency range 300 to 1000 megacycles to be used with 308AS doorknob tube. Cat. No. BC-2

Sockets part of assembly on both. **95c each**

Order by Catalog Numbers!

CONDENSERS

CATALOG NO.	CAP. MFD.	WORKING VOLTS	YOUR COST
C110	1	3000 OIL	$3.95
C111	3	4000 OIL	$4.95
C112	1	1000 OIL	44c
C113	4	500 OIL	49c
C114	6	600 OIL	95c
C115	2	600 OIL	49c

VARIABLE CONDENSERS

100 MMFD variable APC type—Cat. No. T-21. **59c**

30 MMFD variable APC type—Cat. No. T-22. **25c**

12 MMFD variable ⅛" shaft—Cat. No. T-23. **30c**

CHOKES

Thordarson 8 HY 150 M choke—Cat. No. FC-201. **95c**

Thordarson 8 HY 175 M choke—Cat. No. FC-202. **$1.49**

Thordarson 12 HY 25 M choke—Cat. No. FC-203. **39c**

Thordarson 8 HY 350 M choke—Cat. No. FC-204. **$4.95**

Thordarson T48003

Thordarson 2H-7H 550 MA swing choke size 4½ x 5½ x 5½ square black crackle case, Cat. No. FC-205 **$5.95**

Filament Transformers

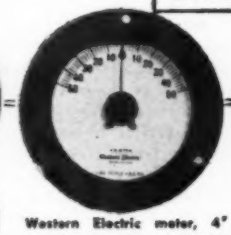
Thordarson 6.3 V—4 amps., 6.3 V—4.5 amp., 9.7 V—.5 amp., pri. 110 V AC 25 or 60 cy—Cat. No. FT-11 **$1.95**

Thordarson pri. 110 V 60 cy.—sec. 6.3 V 6 A, CT—Cat. No. FT-12 **$1.49**

Thordarson 110 V 60 cy. pri., sec. #1—2.5V 10 A CT, 3000 V ins., sec. #2 10 V 3.25 A, Two 5 V 3 A; 6.3 V 1 A—Cat. No. FT-13 **$4.95**

All Orders F.O.B. Detroit

Westinghouse meter, 0-1 MA movement, 2" round case, scale calibrated 0-140 and 0-500. Includes mounting hardware. Cat. No. M-101. **$2.95**



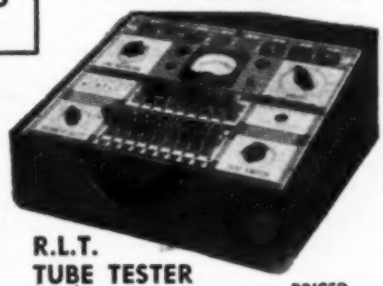
Western Electric meter, 4" round, zero center, 0-½ MA each side. Cat. No. M-102. **$3.95**

Westinghouse meter, 0-1 RF amps, 2" round case, internal thermocouple, in original box. Includes mounting hardware. Cat. No. M-103. **$2.95**

SHALLCROSS ACRA-OHM WIRE WOUND RESISTORS

2,000 ohm	60,000 ohm	±1W
3,300 ohm	65,000 ohm	
9,000 ohm	70,000 ohm	39c each
15,000 ohm	75,000 ohm	
18,000 ohm	100,000 ohm	3 for $1.00
25,000 ohm	150,000 ohm	
30,000 ohm	600,000 ohm	
50,000 ohm		

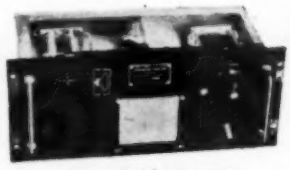
1 MEG..89c



R.L.T. TUBE TESTER

Tests all tubes up to 117 V. • Tests shorts and leakages. • Tests individual sections. • Works on 99-125 V 60 cycle AC. • Comes in portable cabinet complete with all operating instructions with 8d. Cat. No. TT-100

PRICED AT ONLY **$49.95**



TUNING UNIT

Tuning unit BC 375. Approx. 65 MMFD cond., coils, RF chokes, dials, asstd. mica condensers 2500 WVDC, over $50.00 in parts. Cat. No. TU-101. **$3.75**

PHOTO FLASH TUBE

Photo Flash Tube. High speed photo flash tube, 12,000,000 lumens light output. Stops all action. Ignition coil included on back of bulb. 10,000 flashes. Diagrams furnished on request. Your cost Cat. No. PF-101. **$8.95**

SELSYN MOTORS

The ideal way of indicating the position of rotary beams, wind indicator, etc. (400 cycle). Line cord and instructions for 110 VAC operation furnished.—Cat. No. SM-100. **2 for $3.95**

DYNAMOTOR

Power supply—inputs 6 or 12 V, output 500 VDC at 160 MA, mounted on box with circuit breakers, relays, interference filter and two 10 ft. cables. U. S. Govt. surplus. Cat. No. DM-101. **$9.95**

Hot Spot Specials

- Asst. resistors ½ watt fully insulated in popular ohmages per 100—Cat. No. R-5. **$1.49**
- Asst. mica condensers per 100—Cat. No. C-12. **$1.95**
- Wafer sockets 4-5-6-7 & 8 prong per 100 Cat. No. WF-4. **$2.95**
- 12" Utah P. M. Speaker Alnico #5 with 6F6 output transformer—Cat. No. ST-100. **$6.95**
- Asst. knobs push on wood & plastic per 100—Cat. No. KP-100. **$1.95**

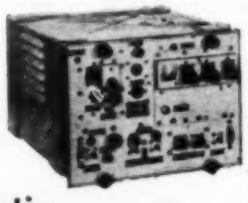
6J4—$1.50, 6J6—95c.

- Johnson sockets #210—25W—Cat. No. JS-210. **49¢**
- 75,000 ohm 200 W bleeder—Cat. No. B-75. **49¢**
- 955-9004 tubes—Cat. No. T-99. **65¢**
- Sockets for acorn tubes—Cat. No. AT-10. **19¢**
- 8-8 MFD 350 WVDC, 20 MFD 150 WVDC, round can—Cat. No. RC-88. **69¢**

Receiver and Transmitter

SCR-522 USED in good cond.

100-156 MC receiver and transmitter complete with 18 tubes. Cat. No. RT-10 **$29.95**



Transmitter and Receiver

Has been widely used on the 144 MC band. Shipping wt. 100 lbs. U. S. Govt. surplus. Your price, less tubes and power transformer. Cat. No. RT-102. **$14.95**

Write for **FREE** *Bulletin*

HERSHEL RADIO CO.

5249 GRAND RIVER DETROIT 8, MICHIGAN

20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

list. A few weeks ago his manufacturer queried as to how many of the new appliances he could use immediately. He got out his list of potential customers and started calling them on the telephone. How many people do you suppose were ready to place an order? Not one!

High on the homemaker's priority list are a toaster and a vacuum cleaner. Of the homes where electricity is now available, you'll find a toaster in 58% of them; a vacuum cleaner in 42%. It would seem that the vacuum cleaner salesman will have a lot of places to sell his wares. Nearly one farm family in four wants to buy one.

About one family in four has a water system with an electric pump. Another 18% plan to install them just as soon as they are available.

The automatic water heater business should also be good. Only 1 family in 20 now has one in operation, but 14% have indicated they intend to make such a purchase soon.

One electrified farm home in 10 has an electric range. But if farm women have their way there will be an electric range in one out of four farm homes.

Other items that the farm homemaker has her eye on are ironers, sewing machines, waffle irons, coffee makers, heating pads, clocks, and automatic furnaces. In fact, a door-to-door salesman should be able to make a sale for each of the items in one out of 10 calls.

Farm homemakers haven't thought too much about such items as dishwashers. They seem quite a luxury to her as yet. She is still trying to get used to the convenience of such things as push-button lighting and not having to fight a balky gasoline engine when she washes.

When it comes to the farm production side of the picture, chick brood-

FCC PRELIMINARY PROPOSAL REGARDING THE CITIZENS' BAND

THE Federal Communications Commission is interested in securing the cooperation of manufacturers and others in preparing technical requirements for equipment to be used in the Citizens' Radiocommunication Service.

The Commission proposes, through subsequent regulations to be adopted, that the 460-470 mc. band be used as follows: 460-462 mc., Class A stations at fixed locations exclusively; 462-468 mc., Class A and Class B stations; 468-470 mc. Class A stations exclusively. It is proposed that Class A stations be permitted a frequency tolerance of .02 per-cent, whereas Class B stations would be given much wider latitude with a permissible tolerance of .2 per-cent. All Class B transmitters, however, would be initially adjusted by the manufacturer or the individual builder of composite equipment to operate within .2 per-cent of the center-band frequency of 465 mc.

Controls for adjustment of the carrier frequency of the transmitter shall not be accessible from the exterior of any unit unless such accessibility is specifically approved by the Commission.

Class A transmitters shall be designed, constructed, and adjusted by the manufacturer to operate on a frequency or frequencies within the band 460-470 mc. subject to the condition that the communication band shall not at any time extend beyond the limits of the 460-470 mc. band. Under all conditions of use in the Citizens' Radiocommunication Service, the transmitter shall be inherently incapable of emitting electromagnetic waves of interference field strength outside the band 460-470 mc.

Class B transmitters shall be designed, constructed, and adjusted by the manufacturer to operate initially, under average conditions, within .2 percent of the frequency 465 mc. Under all conditions of use in the Citizens' Radiocommunication Service, the transmitter shall be inherently incapable of emitting electromagnetic waves of interference field strength outside the band 462-468 mc.

The operating frequency at any time during the period of test shall not deviate more than .02 per-cent for Class A transmitters or more than .2 per-cent for Class B transmitters from the operating frequency measured as soon as possible during the initial period of test operation, under any or all of the following test conditions: gradual and sudden ambient temperature variations from 0 to 150 degrees F.; barometric pressure variations corresponding to those from sea level to 12,000 feet above sea level; relative ambient humidity from 5 to 95 per-cent; atmosphere containing high saline content such as encountered on oceans; movement of objects in the immediate vicinity of the equipment under test; power supply voltage variations normally encountered under actual operating conditions; length of test periods to be equivalent to those which will be encountered under the most severe conditions of operation for which the unit may be used.

The transmitting equipment shall be inherently incapable of operating at a power input of more than 50 watts to the anode (plate) circuit of the electron tube or tubes which supply energy to the radiating system.

The transmitter shall not be capable of producing emissions of any type other than A-0, A-1, A-2, A-3, A-4 or FM unless it is shown after operation under an experimental license that another type of emission is necessary for a definite purpose in the Citizens' Radiocommunication Service.

When radiating amplitude-modulated waves of any type, the percentage of modulation shall not exceed 100 at any time.

When radiating any type of authorized emission, including FM emission, the communication band of the emitted waves shall not exceed .2 mc.

Controls for any adjustment of the receiver which might result, due to improper adjustment thereof, in the radiation of interfering emissions should not be accessible from the exterior of any unit.

—30—

WAR SURPLUS! RADIO PARTS

COMPARE THESE VALUES

Industrial Terminal Board 14 Pole 6½x 1¼x⅜s. Ea.	$ 0.25
RG/8U Coax Cable 52 Ohm. Per Foot	.05
Flexible Tuning Extension Shaft, 90° Angle, 13" Long. Ea. 10 for **$1.75**; 100 for **$12.50**	.25
Electrolytic Condenser Round Can—3x1¼—130 Mfd 300 V, 40 Mfd 50V, 20 Mfd 50V, 10 Mfd 50V. Ea.	.75
Electrolytic Condenser 8-8 475V 3⅛x1¼. Ea.	.75
Filter Choke 20 Ohm 8. Hy 80 Ma. Plus .5 600V Condenser. Ea.	1.00
Filter Choke 300 Ohm 15 Hy. 150 MA 3x 2½x2¼. Ea.	1.00
Filter Choke 1.5 Ohm 1500 VDC 30 Hy. 2.5 Amps. Ea.	1.50
Filter Choke Heavy Duty 200 Ohm 275 Ma. 18 Hy. 2000 VDC 3½x4½x3⅜s. Ea.	3.00
R.F. Coil 6 Turns on ¾" Dia Shielded. Ea.	.50
Oscillator Coil Shielded 3.5 Mc. C.T. Permeability Tuned 42 Turns on ¾" Dia. 2x1⅜s. Ea.	.75
I.F. Midget Transformer 3⅛x1⅞ 2.1 to 2.4 Mc Permeability Tuned. Each	.50
Industrial Rotary Switch Off-On 20 @ 125V. 2x "X". Ea.	.75
Aircraft Toggle Switch 1½x1½x1½ S.P.St. Ea.	.50
Aircraft Toggle Switch 5 Amp @ 110 V.D.P. Position 1½x1¼x1¼. Ea.	.25
Transmitter Tank Rotary Heavy Duty Switch, 6 Contacts D. Pole. Ea.	.75
Padder Condenser 50 to 230 Mmfd. Ea. 10 for **$1.25**; 100 for **$10.00**	.15
17 Plate Midget Condenser 125 Mmfd—Fixed 1x1x1 Ceramic. Ea. 10 for **$1.75**; 100 for **$15.00**	.20
Variable Condenser 5 Plate 12 Mmfd—Screw Tune 1x1x1 Ceramic. Ea. 10 for **$1.75**; 100 for **$15.00**	.20
Variable Midget Tuning Condenser Band Spread .8 Mmfd 3 Plate Ceramic form 1x1x1 ¼" Shaft. Ea. 10 for **$3.00**; 100 for **$25.00**	.35
Permeability Tuning Slug — With Threaded Screw Four Sizes—Midget, Small, Medium, Large. Ea. 10 for **$0.40**; 100 for **$3.00**	.05
Aircraft Pilot Lite for Chassis Mtf. Bayonet Type Universal Socket—Red and Green. Ea.	.25
Resistor Fixed W.W. Adjustable 10½x1 5K Ohm 50 Watt. Ea.	.75
Resistor Fixed W.W. 9½x1 60 Watt 6250 Ohm. Ea.	.75
Variable Coupling Coil Pri-9 Turns on 2½" Form Vari. Sec. 6 Turns 2" Form with Tuning Unit Complete 10 to 25 Watts. Ea.	1.50

Super Values!
UNIVERSAL AC-DC
Frequency 2-30MC
PREPARED KITS
Build Your Own—
RECEIVER-TRANSMITTER-AMPLIFIER

BUILD A RECEIVER!
Kit Includes:
- 1 Chassis 5x33/4x3
- 2 Octal Sockets
- 2 Condensers 100 MMFD
- 1 RF Choke 2.5 M.H.
- 4 Resistors 1-50 M 1-3 Meg., 1-5 M, 1-250 M
- 1 Slug Tuned Coil
- 1 5M Ohm Volume Control
- 2 Filter Condensers
- 1 Toggle Switch
- 1 Roll Coil Wire
- Hook-up Wire and Hardware
- 2 Mica Condensers .003 Diagram Included
- 2 Tubes 1-12 SN7 1-6 SL7
- 1 Condenser 330 MMFD
- 2 125 Ohm 10 Watt W. W. Resistors

Special Value **$4** Per Kit

BUILD A TRANSMITTER!
Kit Includes:
- 1 Chassis 5x33/4x3
- 2 Octal Sockets
- 1 Toggle Switch
- 2 10 Watt W.W. Resistors 125 Ohm
- 2 Mica Condensers .003
- 1 100 M. Resistor
- 1 Roll Coil Wire
- 2 Tubes 1-12 SN7 1-6 SL7
- 2 Slug Tuned Coils
- 1 Filter Condenser
- 1 RF Choke 2.5 M.H.
- 1 Key Diagram Included
- 1 100 MMFD Mica Condenser
- Hook Up Wire and Hardware

SUPER VALUE **$4** Per Kit

BUILD AN AMPLIFIER (AC-DC)
- 1 Chassis 5x33/4x3
- 3 Octal Sockets
- 1-1/2Meg Volume Control
- 2 10 Watt W.W. Resistors 125 Ohm
- 1 Resistor 5M ½ Watt
- 3 Tubes 1-12 SN7 2-6SL7
- 1 Toggle Switch
- 4 Mica Condensers .003 MFD
- 2 Filter Condensers Diagram Included
- Hook-Up Wire and Hardware

SUPER VALUE **$5** Per Kit

SPECIAL
RADIO—FM—TELEVISION—AND ELECTRICAL PARTS
A Perfect Deal for Radio Repairmen—Amateurs and Experimenters

25 pounds of surplus includes:
- 1 Motor Chassis
- Cabinet
- Relay
- Condensers
- Resistors
- Transformer
- Coils
- Sub Assemblies
- Wire
- Hardware, etc., etc.

WORTH AT LEAST $50.00
The same as above —10 lbs.....$3

25 lbs all for $5

LOW PRICED PARTS!

R.F. Choke Low Frequency 200 Ohm 40 Ma. 152 M. Hy. Ea. 10 for **$1.25**; 100 for **$10.00**	$ 0.15
Hi-Freq. R.F. Chokes 60 Ma. ¾x1¼. Ea. 10 for **$1.25**; 100 for **$10.00**	.15
R.F. Chokes 2.5 M.H. Res. 20 Ohm 25 Ma. 1¾x1¼. 4 P.I. Ea. 10 for **$1.25**; 100 for **$10.00**	.15
Resistor Fixed Glass Tubular 20 Watt 31,500 Ohm 4⅜x⅝s. Ea.	.50
Resistor Fixed Glass Tubular W.W. 10 Watt 5K Ohm 4⅜x⅝s. Ea.	.35
Edison Lamp Socket Base 60 Watt 2k Ohm Heater Resistor. Ea. 10 for **$4.50**; 100 for **$40.00**	.50
Resistor Fixed 1 Meg. 20 Watt 8x1". Ea. 10 for **$6.00**; 100 for **$50.00**	.75

IRVING JOSEPH
220 S. Halsted St., Chicago 6, Ill.
Buyer and Distributor of Surplus Stocks

All items listed above are subject to prior sale. Terms cash with order F.O.B. Chicago, Ill. Remit only exact amount of purchase. If prepaid include postage charges.

FREE! Radionic Catalog

Thousands of items, illustrated, described and priced in our new 1947 catalog. Hams, Servicemen, Experimenters, Engineers, Schools, Institutions, Govt. Dept. Industrial Organizations, Laboratories, etc., will find this book a great help in their search for "hard-to-find" equipment.

CHANCELLOR *TUBE PRICES REDUCED*

RADIONIC Is Pleased To Present This New Schedule Of Low Prices:

Where List Price Is	Chancellor Net Is	Where List Price Is	Chancellor Net Is	Where List Price Is	Chancellor Net Is
$0.95	**$0.44**	$1.25	**$0.59**	$2.20	**$1.03**
1.05	**.50**	1.35	**.64**	2.65	**1.24**
1.10	**.52**	1.50	**.71**	3.20	**1.49**
1.15	**.55**	1.80	**.85**	3.90	**1.81**

Order now by type number. Or, send for list of available tubes to Dept. 53. Our on-hand stock varies constantly. Most shipments made within 24 hours.

Chancellor Phono Player Kit

Sim. Leather Portable Case.....
Ballatine Motor.....
Astatic L72 Pick-up...
3 Tube Phono-amp...
Kit of Tubes.....

5" Alnico Speaker with out. trans.....
Needle Cup.....

ENTIRE KIT..... **$21.45**

FTR Rectifier

Each..... **$1.09**
In lots of 12..... **93c**

6 foot zip cord with molded rubber plug.
Each..... **$0.29**
In lots of 50..... **$11.00**

TERMS: In U.S.A. payment in full with order. (Include sufficient for postage.) Or, 25% with order, Balance C.O.D.

MAIL TODAY

RADIONIC EQUIPMENT CO.
170 Nassau St., Dept. 53, New York 7, N. Y.

Please send me a FREE copy of your 1947 catalog.

Name.....

Address.....

MASCO
8 Watt Amplifier and P. A. System Available Again!

MAS-808 Portable system consists of a Model MA-808 amplifier with tubes and cover, mounted in an attractive split carrying case, one heavy duty 10" PM speaker, with 25 feet of cable and plug.....
MA-808 amplifier less cover, with tubes.....
Streamlined cover for above amplifier.....

It's **RADIONIC** *for Everything* **ELECTRONIC**

RADIONIC EQUIPMENT COMPANY

170 NASSAU STREET
NEW YORK 7, N. Y.
Telephone WO 2-0421
Cable Address "CHANSLOR"

ing and poultry house lighting seems to get first call. It is rather surprising to note that 40% of the electrified farms have electric chick brooding equipment. It is not so surprising that 15% of the farms are ready to buy a brooder—largely because of the safety factor. About half of the farms have lights in the poultry house to stimulate winter egg production. Another 13% have poultry lighting equipment on their postwar lists.

It is interesting to note that only 60% of the farms with electricity available have the barn wired. About 30% have lights in the hog house. In this connection one farmer in 16 uses electric pig brooders, but the practice is growing rapidly.

Nearly 30% of the farms have running water in the farm buildings. But 15% more farmers intend to buy electric pumps soon.

One farm in 8 has an electric milking machine. Another 8% is in the market.

Electric poultry water heaters are popular and stock tank heaters are becoming more so.

Only one farm in 8 has an electric powered cream separator. But here again is a wideopen opportunity. One farmer in two intends to buy a separator.

Most of the equipment to be purchased on the strictly farm side of the picture are those that are powered by small motors. Power equipment for the farm shop with an electric tool grinder at the top of the list, will be popular. Since farming is becoming more and more a highly mechanized business, electric welders are going to be in great demand.

But don't expect a great number of large motors for stationary power to be purchased very soon. A few grain elevators are being electrified, as are fanning mills and corn shellers. But until a hammer mill can be put on the market that can be powered by a three-horse electric motor, and operate automatically, they will not be too popular. Mark Collier, a Muscatine County, Iowa, farmer, explains that he can hardly afford to own a large electric motor for a few jobs, when he already has a big investment in his farm tractor.

The farm market is a quality market. Farmfolks for the most part will be buying dependable equipment made to stand up under the strain of hard everyday use without breakdown interruptions. They will be buying from established or reputable dealers with a record of service. What's more they will want equipment and appliances made by manufacturers with a record for dependability—who will stand solidly behind their dealers.

State College, the U. S. Department of Agriculture, Rural Electric Associations and Public Utilities all are making every effort to provide farmers with information that will enable them to make wise selections. They will also attempt to provide information that will assist the new purchaser

to get the most out of the particular price of equipment purchased.

Utility concerns, both public and private, are urging land grant colleges to provide complete and unbiased information relative to the selection, use and operation of electrical equipment. And further, that necessary research be conducted to determine the required facts.

It is of course well recognized that by far the greatest majority of manufacturers are desirous of producing a reliable product. But it must also be recognized that the large potential purchasing power of farm people will induce a few manufacturers to place some new equipment on the market before it has been adequately tested.

And remember, too, farmers are the best judges of quality in the world. They are shrewd bargainers and are not easily misled by the smooth "high-pressure" salesman. They've seen him before.

-30-

Generating Microwaves
(*Continued from page* 37)

where electrons leaving the cathode later than others actually travel faster and overtake slower electrons.

The magnetron is a diode functioning by the effect of a powerful fixed or electromagnet through which electrons leaving the cathode must pass or cut through in order to reach the anode. The magnetic field causes the electrons to have the following behaviors: *a.* If electron travel is parallel to the magnetic field flux, it will have little or no effect on the electrons in their transit from cathode to anode. *b.* If electron travel is at an angle to the magnetic field flux it will be subjected to efforts of the magnetic

OLD TIMERS' NITE

THE Delaware Valley Radio Association of Trenton, New Jersey will sponsor its Third Annual Old Timers' Nite, and banquet on Saturday evening, March 22, 1947.

The affair will be held in the Terrace Room of the Stacy-Trent Hotel, West State Street and Willow in downtown Trenton. A turkey dinner will be served promptly at 6:30 p.m.

Guest speakers will include Old Timers in the wireless field and men who have been prominent in all branches of radio for many years. W2ZI's (ex-W3ZI) famous collection of old time wireless gear will be on display. Many Old Timers of the area are expected to turn out for the event. Door prizes will be awarded and a special award will go to the "Grand OM" whose radio experience dates back to the earliest days of wireless.

Reservations must be made before March 15th with Ed. G. Raser, W2ZI, Secretary, Delaware Valley Radio Association, 315 Beechwood Avenue, Trenton 8, New Jersey. The tariff is $4.00 per person up until March 15th, with late comers being assessed $5.00 for tickets purchased at the door.

-30-

field. This will cause the electron to deviate from a straight course. It will take a spiral or circular course depending on the speed of the electron and the strength of the magnetic field. It can even travel in a circle in the intervening space between cathode and anode and not even reach the plate. This deviation, due to the effect of the magnetic field, is called the electron's "trajectory path."

The lighthouse or disc seal tube is similar to a conventional tube except that the cathode, grid and anode are constructed in simple, parallel planes or layers instead of being fitted axially one around the other. Such tubes make it possible to reduce the inter-electrode distance between the elements to a very few thousandths of an inch. The electron transit time therefore becomes very small so that a tube working by conventional principles can reach a much higher frequency before phase shift becomes excessive.

Conventional tubes in special circuitry may generate microwaves by either the Barkhausen-Kurz or the Fonda-Freedman techniques. The former has been abandoned because of its low efficiency while the latter is becoming increasingly important as the information is made public after war-time secrecy requirements.

The Barkhausen-Kurz method develops microwaves by reversing the potentials normally used in conventional vacuum tubes. The grid is made highly positive while the plate is made zero or even slightly negative in potential with respect to the cathode. The behavior is as follows:

When no signal is present

1. Electrons from cathode are accelerated by the highly positive grid.
2. Some electrons pass through the grid wire openings and continue in the direction of the plate due to their acceleration by the grid.
3. The plate being slightly negative with respect to the cathode, as well as very much negative with respect to the grid, the electron slows down and stops before it can reach the plate.
4. The electron then is attracted back to the highly positive grid.
5. If it misses the grid wire again, it may reach the cathode.

When signal is present

1. Electron leaves the cathode as in the no signal case.
2. It is accelerated by the positive grid which is now increasingly positive or negative by the amount of the signal voltage so that it has a corresponding acceleration or deceleration.
3. The electron passes through the grid wires (except for those which strike the grid) and may manage to reach the plate if the grid was more positive. If the grid was more negative it will stop further from the plate.
4. Those electrons which do not reach the plate will turn back as in the no-signal case.

The efficiency of this type of oscillator is 1 to 5% and therefore unpopular.

Electric Utilities.
Gas Utilities.
Water Utilities.
Fixed Public Services.
Geophysical Services.
Bus Communication.
Truck Communication.
Taxi Communication.
Common Carrier Urban Mobile Services.
Common Carrier Highway Mobile Services.
Coastal Telegraph and Telephone Services.
Coastal Harbor Stations.
Provisional Radio Stations.
Motion Picture Radio Stations.
Rural Radiotelephone Services.
Television.
Facsimile.
Relay Press Services.
Police/Fire/Forestry/Sheriff Conservation, etc.
Transit Utilities.
Educational Broadcasting.
Citizens Radiocommunication Service.
Radar.
Amateur Radio.
Meteorological Radio Stations.
Aviation Glide Path Stations, Localizers, Markers, etc.
Railroad Radio.

Table 2. FCC allocation of frequencies in the microwave region between 300 and 30,000 mc. that may be utilized by these services.

The Fonda-Freedman technique which some Navy patent attorneys have called the "Electron Grouping" principle utilizes conventional tubes energized in the normal way. The voltages applied may be exactly those specified in manufacturer's tube manuals for tubes used on lower frequencies. Correct functioning is obtained by either of two methods:

Out-of-phase Method

$$\text{Transit time} = \frac{n}{f}$$

In-phase method

$$\text{Transit time} = \frac{2m+1}{2f}$$

where: n is any number not including zero.
m is any number including zero.
f is the frequency.

In the case of the out-of-phase method, the tube will generate ultra- and super-high frequencies if the transit time is equal to any number of periods of oscillation such as 1, 2, 3, etc.

In the case of the in-phase method, the tube will also generate ultra- and super-high frequencies if the transit time is equal to any odd number of half periods of oscillation such as ½, 3/2, 5/2 etc.

The efficiency of the Fonda-Freedman technique is high. Its disadvantage or advantage, depending upon the utilization, that causes much concern is the fact that the tube develops a series of discrete frequencies. This series may be shifted to reach any part of the frequency spectrum but will not exist as a single frequency except where resonating provisions are made available. Half the frequencies in the discrete series may be highly attenuated and eliminated with

their power going into the remainder by simple condenser tuning provisions. More elaborate control requires special provisions such as wave guides and cavities correct for the desired frequency and incorrect for the superfluous frequencies. Strong indications are currently being obtained in the range of 100 to 1000 megacycles. Feeble indications have already been detected as high as 50,000 megacycles from a 6N7 tube even though no more than a pair of headphones to which was attached a silicon or galena crystal detector, was the method used to measure the maximas and minimas in terms of wavelength.

Little information has thus far been disclosed on the Fonda-Freedman developments as the inventors are not free to discuss same since patent arrangements are not as yet completed.

In appreciating the use of microwaves or in preparing to procure such facilities, readers are cautioned that the most satisfactory techniques and equipment have not yet been made known or sold to the public. Much secrecy has existed and continues to exist as firms invent, develop and compete in order to have a complete and more novel microwave communication system. They have their sights trained on the microwave relay networks, radar, and two-way radio communication fields.

Table 1 compares the various tubes and techniques which have successfully generated microwave frequencies to date. The Federal Communications Commission has allocated frequencies in the microwave region between 300 and 30,000 megacycles which may be utilized by the services or groups shown in Table 2.

—30—

DELUXE PHONOGRAPH OSCILLATOR*

THIS simple, easy-to-build unit will give high-quality performance when used either with a crystal phono pick-up or a crystal microphone. Output is sufficient to operate a radio receiver located 50 to 75 feet away.

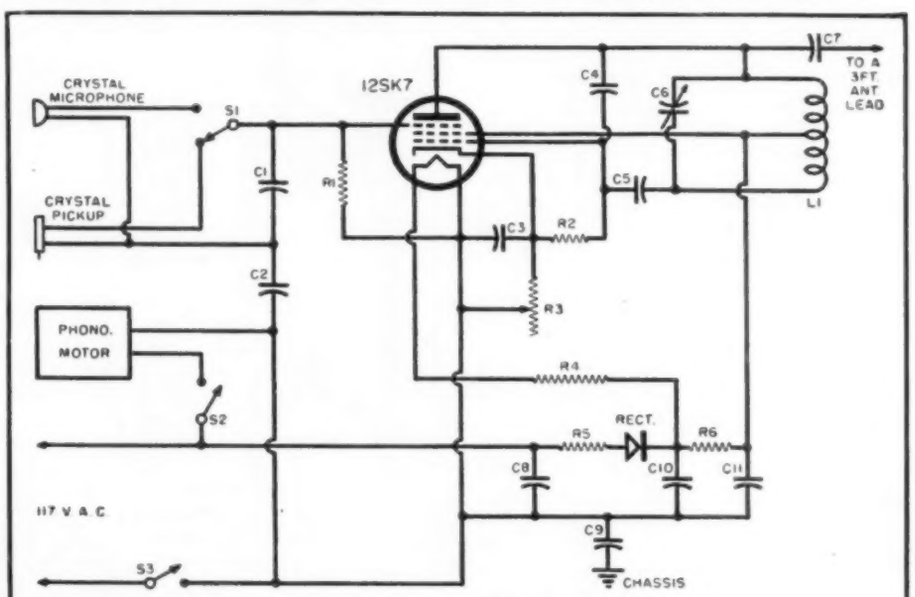
The oscillator portion utilizes the control grid, screen grid, and plate of a 12SK7 tube. The audio modulating voltage is impressed on the suppressor grid, and the per-cent of modulation may be varied by adjusting R_3, which controls the cathode potential of the 12SK7.

The power supply consists of a selenium rectifier and filter circuit, and provides d.c. for both the plate and heater of the 12SK7 tube. This reduces the possibility of hum modulation due to a.c. operation of the heater, eliminates the need for a transformer, and reduces the amount of heat dissipated within the unit. The total d.c. current drain is under 200 ma., so a 200 ma. rectifier or two 100 ma. units in parallel may be used.

To adjust for proper operation, the unit is turned on and a phonograph record played. The radio receiver is tuned to a clear spot on the dial, preferably in the neighborhood of 1600 kc. Condenser C_6 is then adjusted until the signal is heard at maximum loudness on the radio receiver. This means that the radio receiver and the tuned circuit L_1-C_6 are both tuned to the same frequency. R_3 is adjusted for maximum clarity of the audio signal, and the unit is ready for operation. —30—

* Schematic diagram for this unit was supplied through the courtesy of Federal Telephone & Radio Corporation.

Either voice or recordings can be transmitted with this simple phono oscillator.



R_1—4.7 megohm, ½ w. res.
R_2—47,000 ohm, ½ w. res.
R_3—10,000 ohm rheostat (adjust. for % of modulation)
R_4—740 ohm, 20 w. res.
R_5—22 ohm, ½ w. res.
R_6—7000 ohm, 1 w. res.
C_1—500 μμfd. mica cond.
C_2, C_3, C_9—.05 μfd., 400 v. cond.
C_4—10 μfd., 25 v. dry elec. cond.
C_4, C_7—25 μμfd. mica cond.
C_5—250 μμfd. mica cond.
C_6—20-160 μμfd. var. cond.
C_{10}, C_{11}—40 μfd., 150 v. elec. cond.
S_1—S.p.d.t. sw.
S_2, S_3—S.p.s.t. sw.
L_1—Broadcast ant. coil c.t. (1000 to 1700 kc.)
Rect.—200 ma. selenium rectifier (or two 100 ma. rect. in parallel)
1—12SK7 tube

minutes later—though still with a peacetime beard—I sat behind the wheel, driving full-throttle to the station. We went on the air and told a stunned world what was happening. Like thieves at night, the German Wehrmacht, armed to the teeth, flooded over our borders and the peaceful soil of Holland resounded with the rattle of tanks and the heavy thud of hobnailed, ugly Kraut-boots. The brutes were coming. They dropped out of the air, machine-gunned our roads, bombed our towns, while Goebbels' poisonous propaganda bombarded us with lies and threats: 'We come as friends . . . or we shall smash you!'

"For four days and nights, PCJ reported the coming of the hordes and the stubborn resistance of a small army that fought bravely to stem the onslaught of a vastly superior enemy. Then came the blow that shook the earth for miles . . . PCJ was blown up in the air by ourselves—rather than let it fall into the hands of the enemy! And what was not destroyed by the explosion was consumed by the flames of a roaring fire. Our pride, the big rotating beam antenna—the only one in the world—a masterpiece of skill and engineering, lay pole-axed along the ground. It was a ghastly sight. After 12 years of short-wave pioneering and goodwill programs to the world, PCJ, the *'Happy Station,'* was no more . . .

"'Vat happened here,' asked two Nazi officers who came to see the destruction. 'Oh, somebody must have pushed the wrong button,' I suggested, wild with rage inside.

"'The 'rong button? . . . what do you mean?' said the Boche, giving me a dirty look. He pointed to the sky where a squadron of German bombers flew in westerly direction. They were flying low showing their crosses on the wings to rub in their prowess and their power. 'See that,' said the German. 'They are heading towards England and in a few weeks we'll be standing on the ashes of London.' 'Sez you!' I thought, while trying to find a German equivalent, which I did not. Instead, I simply said, 'I doubt very much you will ever get there!'

"The Nazi took my remark with arrogant superiority. He was convinced the Fuehrer had calculated every possibility and every trick. But the Dutch knew better. As a seafaring people, they instinctively knew that the little stretch of water and the Bulldog behind it could do more than all the Goebbels' propaganda ever concocted.

"The war went on and the Gestapo moved in. PCJ had to be rebuilt by forced labor, to pump the German propaganda overseas. That's when yours truly beat it, retiring from radio for the entire period of the war. A broadcaster became a listener—out-

side listening in. How he squirmed through the intricate net of endless Nazi trickery is a story for some other time.

"Shortly before the invasion came in 1944, a storm swept through the high antenna masts of PCJ's rotating beam, putting the directional mechanism on the circular rails out of order. Through clever sabotage of the engineers, the mechanism proved irreparable with the result that for the remainder of the war, all Nazi broadcasts were directed to the North and South Poles, where polar bears enjoyed excellent reception!

"When the armies got locked near Arnhem in the, starvation winter of 1944-45, the retreating enemy pillaged and looted everything that they could lay their hands on. So after four and one-half years of hiding it, PCJ's ample file and fine records—collected from all parts of the globe for the enjoyment of its listeners—was carried away and was never seen again.

"Finally, when after many years of anxious waiting, liberation came to starving Holland, PCJ was demolished again—now by the Germans. Yet, fortunately, they had no time to blow it up entirely, while some idiots even thought they would be back. And so after a few good meals with allied rations, PCJ's engineers spit in their palms and went to work to rebuild in record time the *'Happy Station'* to bring again to the world that well-known spirit of *P*eace, *C*heer and *J*oy (PCJ)—thanks to the great Allied Victory!"

And so it was that once again PCJ took its rightful place among the greatest of short-wave broadcasters! Once again its *"Happy Station Program"* is the star feature on the Netherlands Overseas Services, having such a far-flung audience of assidious friends that it can easily be considered as one of the most popular features aired on short-waves around the globe. Eddie tells me "the audience is growing by the month, and the underlying spirit being the fostering of friendly and peaceful relations by mixing music with human-interest stories, is once more proving the reason for its success."

Mr. Startz is planning for a worldwide PCJ Birthday Party—celebrating the 20-year jubilee of the station—this spring, probably some time during March. Announcement will be made well in advance over the microphone, in the *"Happy Station Programs,"* which are now radiated as follows:

Sundays and Wednesdays—10:30 a.m.-12 noon, 15.22, 11.73, 6.02, to East and Near East; 4-5:30 p.m., 11.73, 9.59, 6.02, to Africa and Mediterranean; 9:30-11 p.m., 11.73, 9.59, 6.02, to the Americas. *Tuesdays*—3-4:30 a.m., 11.73, 9.59, 6.02, to Pacific, Australia, and New Zealand. (These times are EST.)*

Reports to PCJ are always wel-

* Unless otherwise indicated, all times mentioned herein are American EST, 5 hours BEHIND GMT.

comed and an attractive verification card answers all correct reports; address, PCJ, Postbox 150, Hilversum, Holland (Nederlands).

Facts About Holland

Before a closing comment from Mr. Startz, here are a few pertinent points about The Netherlands.

The Kingdom of the Netherlands *(Koninkrijk der Nederlanden)*, in northwestern Europe, has an area of 12,862 square miles, with a population (estimated, January 1, 1944) of 9,090,000. Amsterdam is its capital.

Holland is bounded by Germany on the east, Belgium on the south, and the North Sea on the west and north. Its surface is flat, with an average height above sea level of 37 feet, and with about one-fourth of its land below sea level, reclaimed and protected by dykes, of which there are 1500 miles. Drainage of half of the shallow Zuider Zee, which covers 1350 square miles, with an opening into the North Sea about 19 miles wide, designed to add 900 square miles to the cultivable land—"polders"—has been under way since 1920.

The Hague is the official residence of H.M. Queen Wilhelmina and the seat of her Government—but Amsterdam is the sole capital of the Kingdom and the inauguration of the King or Queen—in accordance with the constitution—takes place in that city.

Cereals, potatoes, sugar beets, and other crops are raised. Dairy products are an important industry; the cheese products are famous and the cattle high grade. On the very special type of soil found on the edge of the polders and the sand dunes along the coast, tulips and other flowering bulbs and roots are grown. The Dutch bulb is not indigenous to Holland but originated in Persia, whence it was taken to Holland 375 years ago. The village of Boskoop, with 600 nurseries, is the largest center in the world for flowers and ornamental plants, it is claimed.

Most important industries before World War II were shipbuilding, the manufacture of machinery, textiles (including rayon), and chemical products; also brewing and distilling and flour milling. Amsterdam is famous for diamond cutting; Delft, for pottery.

Canals, of which there are 4817 miles, are most important in internal communication and transportation; elaborate systems are in the cities and feed the harbors. The Rhine and the Scheldt reach the sea through the Netherlands and carry enormous traffic, the Scheldt carries traffic including that from Antwerp (Belgium).

The Dutch Constitution assures a hereditary constitutional monarchy. Executive power rests exclusively in the Sovereign and the States-General of two Chambers. Universal suffrage for citizens of both sexes over 25 years of age and proportional representation are in force.

The reigning Sovereign is Queen Wilhelmina Helena Pauline Maria

who succeeded on the death of her father (Willem III), November 23, 1890, and who was crowned September 6, 1898. Heir to the throne is Princess Juliana, only daughter, who is married to Prince Bernhard of Lippe-Biesterfeld.

Germany invaded The Netherlands on May 10, 1940, and occupied the country. Queen Wilhelmina and her cabinet escaped to England and established the Government in London. The Netherlands declared war on Japan, December 8, 1941, and on Italy, December 11, 1941. German troops surrendered on May 4, 1945.

Army service is compulsory with every man liable from the ages of 20 to 40.

Entire liberty of worship and conscience is guaranteed.

Education is obligatory from ages seven to thirteen; instruction is free or subject to a small fee, in both public and denominational schools; teachers are paid by the State. There are several fine Universities.

Tribute to SW Radio

In closing, we leave with you a tribute to short-wave radio as paid by Eddie Startz in an early publication of PCJ (1929):

"Short-wave broadcasting as we know it today is the outcome of many years' indefatigable research and profound study of short-wave technique and propagation phenomena. The larger short-wave stations radiate their programs to every corner of the world, building a mysterious bridge between the loneliest spots of the earth and civilization, from Arctic to Antarctic, from Continent to Continent. Short waves encircle the world, they convey messages of all kinds from and to every conceivable spot, conquering the old enemy, distance, that used to be such a barrier to the progress of mankind. That is why papers write, people talk, and engineers think about it. Short-wave broadcasting means that a long-cherished dream of mankind—the elimination of distance—has come true in the fullest sense of the word. Listeners are scattered over the entire earth and are particularly numerous in the tropics and in the isolated regions where man is deprived of the comforts of civilization. That is where short waves reign supreme, as the longer waves do not reach so far, or if they do, they are drowned by the severe atmospherics which are such a distress to the listener.

"In the remote corners of our world, at the outposts of civilization, in the desert or on the high seas, up in the peaks of the Himalaya mountains or the Cordilleras de los Andes wherever man is shut off from the rest of the world, there we shall find the short-wave fan. For him short waves are the only link with his fellowmen at home and are his only diversion. For him stations like PCJ mean home and all it stands for, conjured up and made audible by the mere turning of a tiny knob of his short-wave receiver . . .

the magic portal beyond which lies the outside world . . .

"It cannot be denied that in long-distance transmission there is a fascinating something decidedly worthy of the term 'romance.' There is a thrill for both listener and speaker, through the personal contact that is maintained between two people who are separated from each other by such tremendous distances as only short waves will bridge."

Of his long years before the PCJ microphone, Eddie Startz reports that one of his most interesting early experiences "was the rebroadcast of the 1929 PCJ Christmas program for the United States. This transmission was picked up with perfect strength in America and was rebroadcast by the National Broadcasting Company over a large network of stations extending over the entire country. So successful was this experiment that we received over 3000 letters from listeners, enthusiastically expressing their appreciation of our efforts. A good many of these communications were from our countrymen abroad, who were deeply moved when listening to their mother-country over such a great distance. Another remarkable feature in the history of the station was when the old world was again linked up with the new—but this time with the South American Continent. Under the auspices of the Brazilian Ambassador in Paris, a concert played in the French metropolis was transmitted by PCJ to Brazil, where it was successfully rebroadcast at Pernambuco, Rio de Janeiro, and Sao Paulo."

As to his method of conducting the *"Happy Station Programs,"* Eddie makes this comment: "Although I can safely say that short-wave listeners are a very grateful and appreciative audience, experience shows that they like to be treated individually. Listeners appreciate hearing their countries and towns mentioned during the programs (especially at *Mailbag* time), and it is often difficult to do justice to everyone at a time, considering the innumerable listeners of the station. . . . But in my mind I have been with listeners all over the globe, talking to them in their own language, while interposing personal remarks and calling many by name, thanking them for their reports and cooperation. The PCJ family is large and a universal spirit of sportsmanship prevails among the listeners.

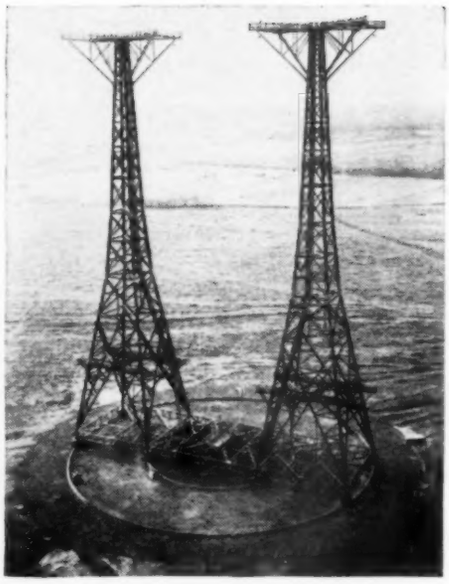
"It is indeed a great satisfaction to note the interest and sympathy for the *'Happy Station Programs,'* which is so distinctly reflected in the thousands of letters pouring in from listeners all over the world. Not only do these reports and messages of appreciation contain valuable material for our engineering staff, but they are equally valuable as a stimulus to our future efforts in broadcasting. The communications might be compared to the spontaneous response of a theatre audience without which the actor would be unable to play his role effectively.

"Through this reaction on the part of the listener, the enthusiasm is continually kept alive. It is for this reason that when addressing the microphone I know that I am not merely talking to a lifeless instrument *but that my words are heard by countless numbers of short-wave friends in almost every country under the sun!*"

* * *

NAVE Will Verify

From H. H. Holton, Commander, U.S.N., Officer in Charge, Radio-Television Section, Office of Public Information, Navy Department, comes this official information regarding NAVE, the transmitter of the Navy Antarctic Expedition:



PCJ's rotating beam antenna, the only one of its kind in the world. The prewar one was destroyed by the Dutch rather than let it fall into the hands of German invaders.

"The Navy Antarctic Expedition has provided aboard the U.S.S. *Mount Olympus* broadcasting facilities for equal use among the four major (U.S.) radio networks.

"Since Navy responsibility for the broadcast ends once the signal has left the *'Mount Olympus'* antenna, the networks have arranged to pick up the signal through RCA and Press Wireless. The frequencies allotted for use by the Naval Communication Service are 9.280, 9.670, 12.265, 15.930, 17.820, and 20.040. In addition, RCA has been utilizing its own frequencies. Naturally, the use of any one frequency has not been standardized yet because of varying and unpredictable atmospheric conditions.

"Considerable thought had been given communication with radio amateurs, but since the communication personnel with the expedition are fully engaged with normal operating communications, audio-radio broadcasts to the American people through the four major networks, radio-teletype, radio-photo, and establishing communication with the Navy airplanes making reconnaissance flights over the Antarctic continent, time and personnel are just not available for amateur radio communications.

"If radio listeners and amateurs wish to verify reception of 'NAVE,' it is requested that they mail their requests to the Radio-Television Section, Office of Public Information, Navy Department, Washington 25, D. C., U.S.A.

"It must be borne in mind that the operating radio log is being maintained aboard the *'Mount Olympus'* and that there is no mail service to the Antarctic. *Therefore, answer to requests for confirmation of radio reception will require five to six months. Please advise your readers not to send requests for confirmation to the 'Mount Olympus.' Such requests will be handled here. It is also urged that amateurs refrain from trying to raise NAVE in view of the expedition's present work-load."*

Information on reception of NAVE comes from Bill Arthur and Lynn McLaughlin, Charleston, West Virginia, who have been carefully monitoring NAVE:

"NAVE has been using a transmitter which they rate as 350 watts, but a 2.5 kw. transmitter was picked up in the Canal Zone and is probably now in use. While schedules of NAVE are for the most part irregular, they usually contact the United States around 7:30 a.m. and 6:30 p.m. EST (1230 and 2330 GMT), daily.

"Thus far, the 17.82 frequency has been heard more here than the others, although it usually suffers interference from U.S. broadcasters in the 16-meter band.

"Apparently, NAVE uses a variable frequency oscillator—or equivalent—as frequencies can be shifted by small

amounts in order to avoid too much interference from other nearby transmitters.

"At times the contacts have not been too successful, in fact sometimes have not been completed. However, we have usually been able to read both sides here.

"Press Wireless contacts have included WBE, 19.580; WBH, 22.780; WHJ, 17.440; WBG-5, 15.610; WJS, 15.700; WJQ, 10.010; WRP-2, 23.450. RAC contacts have included WBU, 21.26; WQE, 18.920; WLL, 17.900; WQD, 18.960; WQV, 14.800; KQZ, 17.980; KEL-2, 21.220; KES-3, 10.620; KLL, 13.720; and others."

If tests on the 20.040 frequency are successful, I believe it is quite likely that it will be used a great deal in the future. Watch for this "high" one!

* * *

Re Newscast Table

The *English* newscast table compiled for this issue of the ISW Department was prepared with a view of serving readers in many countries. Not all stations listed will be audible in any given area. Since this table should also serve to some extent as a worldwide log, an effort was made to include all *known English* news periods. It must be remembered, however, that station schedules are subject to change without notice, and that changes are taking place almost daily.

Especial thanks go to Paul Dilg and August Balbi, California, and to Roger Legge, New York, for their valuable assistance in the preparation of the table.

* * *

Australia's DX Sessions

Direct via airmail from Ernest H. Suffolk, DX editor for *Radio Australia*, comes this timely information:

"*Radio Australia* seeks DXers reports on signals, guarantees to verify all correct reports, and will answer all letters. An old-time DXer, Graham Hutchins, has been engaged to attend to this matter and is now on the staff of *Radio Australia* for this purpose alone. I will acknowledge and give a 'cheerio' over *Radio Australia* for all reports addressed to the DX Editor, Radio Australia, Melbourne, Victoria, Australia.

"Current schedules for the DX programs are:

"Saturday, to Eastern U.S. and Canada, 7:20 p.m. over VLA9, 21.600; Sunday, to Western U.S., 12:25 a.m., over VLB8, 21.600 (or VLB9, 9.615), VLC4, 15.32, VLA4, 11.770 (or VLA8, 11.760), and VLG7, 15.160; Saturdays, to British Isles, 5:15 p.m., over VLB6, 15.200, VLA4, 11.770, and VLC10, 21.680."

* * *

Addresses

The following station addresses were sent us by Pat Casey, New York:

HH3W, P.O. Box A117, Port-au-Prince, Haiti; CFCX, 1231 St. Catherine Street, W., Montreal, Quebec, Canada. Reports to CMAN, CMCY, COCY, CMHI, COHI, CMJN, CMKV, CMKN (some of these are medium-wave outlets) may be addressed to Ra-

dio Havana Cuba, Apartados 770-799, Havana, Cuba.

* * *

Spanish Stations Skeds

From K. Dobeson, England, official agent for the Spanish Broadcasting Network, we have received this information:

"Spain is desirous of receiving reports on Spanish radio stations, either sent to them direct at Radio Nacional de Espana, Madrid, Spain, or to me at Globe Hotel, Chichester, Sussex, England. All queries will be answered.

"Madrid, Radio Nacional de Espana, 40 kw., 32.02 m., 9.369, is scheduled 2:45-5 p.m. and 6:30-9 p.m.; in Russian at 2:45 p.m.; *English,* 3 p.m.; Arabic, 3:30 p.m.; Spanish, 3:45 p.m., to African colonies; French, 4 p.m.; Portuguese, 4:30 p.m.; German, 4:45 p.m.; Italian, 4:52 p.m.; at 6:30 p.m. is beamed directly to *Hispanoamerica* in Spanish. Other programs are being planned, including one to North America; there are irregular broadcasts to North America now, such as on November 2 when there was a talk by the Scotsman, Halliday Sutherland.

"Alicante, Radio Falange de Alicante, 37.7 m., 7.940, is scheduled 8:30-10 a.m. and 3-6 p.m.

"Madrid, Radio SEU, approximately 42.55 m. (sometimes changes frequency because of interference), usually is heard around 7.010, is scheduled 10 a.m.-2 p.m. and 3-6:30 p.m., irregularly to 7 p.m.

"Cuenca, Radio Nacional de Espana en Cuenca, 42.25 m., 7.100, is scheduled 8-10 a.m. and 3-7 p.m.

"Oviedo, FET22, Emisora de la Falange de Oviedo, 42.6 m., 7.042, is scheduled 6-7 a.m., 7:30-9 a.m., and 2-6 p.m.

"Valencia, Radio Mediterraneo de Valencia, 3 kw., 42.63 m., 7.0372, is scheduled 7-9 a.m. and 2-6 p.m.

"Malaga, Radio Nacional de Espana en Malaga, 42.79, 7.012, is scheduled 8-10 a.m. and 3-7 p.m.

"Valladolid, FET1, 6 kw., is scheduled 7:30-9 a.m. and 3-6 p.m.

"Tenerife, 'Club Tenerife,' EAJ43, 20 kw., 41.28 m., 7.267, is scheduled 6:30-8 a.m. and 12:30-5 p.m.

"Spanish Morocco, Tetuan, 'La Voz de Espana en Africa,' 49.45 m., 6.070, 20 kw., is scheduled 2-7 p.m.

"Tangiers, approximately 42.5 meters (7.059) and on one other frequency in the 41-m. band, uses Spanish, opens at 1:30 p.m., is heard at 3 p.m. in England, and is presumed to closedown either at 6 or 7 p.m.; this one may not belong to the Spanish Broadcasting Network, but is received with good strength here in England."

* * *

Last Minute Tips

Direct from Dr. Siegmund Guggenberger, Public Administrator of the Austrian Broadcasting System *(Radio Wien),* comes this late news of broadcasting activities in Austria: "All these last months we had to contend with almost unsurpassable difficulties, and still we attained remarkable success with the reconstruction of the Austrian Broadcasting System. This

was due to a great extent to the amicable attitude of all the foreign broadcasting organizations. We were spurred in our work, however, by another idea still: Although Austria is but a little country, it is within the focus of world political interests. Foreign countries generally get their information from authorities who—in spite of their friendly disposition—might not always have the necessary insight into Austrian affairs which might enable them to judge fairly. The voice of Austria itself—its radio—shall speak to the world again. We expect to reconstruct our big radio station—Bisamberg—and to realize the reunion of all the Austrian broadcasting stations in the near future. Then we shall make it our noblest task—following the good Austrian tradition—to offer a standard program which will find an echo in all foreign countries."

Overseas radio journals report that "a powerful new short-wave station, to be called *'Radio Haiti,'* is to commence operation early in 1947. It will be the most powerful station in the West Indies, having a power of 150 kw. There will be three transmitters, providing beam services to Europe, Africa, North, Central and South America. Programs will be radiated in four languages—French, *English*, Spanish, and Portuguese. The following channels have been allocated: 6.077, 6.200, 9.563, 9.620, 11.815, 11.820, 15.300, 17.150, 21.500, and 21.670." (*Short Wave News, London*) *(Your ISW editor would appreciate further information on "Radio Haiti," as it becomes available.)*

At last report, the two short-wave transmitters long reported under construction in New Zealand had not taken to the airwaves, the holdup being the building of suitable antenna arrays. Site of the transmitters is at medium-wave 2YA, just outside Wellington.

Around the New Year the following interesting letter was sent out by Yves Samsioe, an official of *Radiotjanst* (The Swedish Radio), Stockholm: "Hereby just a few lines from the Swedish Broadcasting Corporation to thank you for your collaboration this year and for the excellent reports of reception you sent us. A new year is now coming, a year, we hope, of peace and prosperity. We don't know yet what we can offer you in radio questions, I mean programs a.s.o., but we can assure you that we are doing our best to make this year of 1947 a better one than 1946. We shall still be working with our 12-kilowatt transmitters even this year, but the programs will be a little bit different, more music and especially more announcements telling: 'This is the Swedish Broadcasting Corporation.' Please continue listening to us and send us reception reports. They are, we assure, most useful to us. Address is Radiotjanst, Kungsgatan 8, Stockholm, Sweden (Sverige)."

Mr. Samsioe has informed me that *Radiotjanst* is considering the possibil-

ity of a weekly "goodwill" DX session for short-wave listeners "around the world." The pattern would probably include good music and acknowledgement of letters and reception reports received from listeners. Details will be announced as soon as they are available.

Incidentally, Stockholm is now using SDB-2, 10.780, to parallel SBT, 15.155, in the daily North American beam (*English* and Swedish), 10-10:55 a.m.

An unknown Chinese station has been heard lately between 9:15-11 a.m. on about 6.390; call sounds something like "XPRA"; sign-off is with the Chinese National Anthem. XGOUS, Nanking, has been heard around 8:30-9:15 a.m. lately on various frequencies, including 6.935, 7.530, 7.548, and 7.090; relays press dispatches and appears to be experimental. (Dilg)

The Chinese station (listed by Australians as XMTA) on about 12.115 is being heard in Sweden around 5:45-7 p.m., usually with news in Chinese at about 5:45 p.m.; uses various calls so is evidently relaying a number of stations; among calls heard are XGON, XGNC, XNGR, XNTX, XNY, and XNTR. (N. Johnson) Other Swedish reporters list location as Yenan; if so, may be Communist-controlled. From "Down Under," location is reported as Shanghai, and is said to have *English* news irregularly around 6:30 a.m. Has been heard irregularly by Paul Dilg, California, early mornings, but *no English has been noted.*

A Chinese station on 9.555, believed to be Chungking, is being heard in Sweden between 8:45-9 a.m. (N. Johnsson) XOPD, Hangchow, is listed on this frequency.

On about 4.230, Paul Dilg, California, has recently been hearing an AFRS station in Nanking, China, giving an "XM. ." call, around 9 a.m.-12 noon. May be a harmonic.

Early in January, time of the "evening" *Radio Australia* beam to Eastern North America was changed; is now heard 6:30-7:45 p.m., with news at 7 p.m., over VLA9, 21.600. Officials of *Radio Australia* inform me that this change was effected that "reception might be more clear." Tests conducted on VLC4, 15.320, late in December, in an effort to find a satisfactory outlet to parallel VLA9 in this transmission, were poor, due to interference from a U.S. transmitter.

SVL, 7.295, Athens, Greece, has poor signal due to interference; scheduled 2:58-3:45 p.m. with Greek news at 3 p.m.; program is interspersed with swing records, off with march; *no English noted.* (Bromley)

ZBW, Hongkong, appears to be on 9.540 currently; has weak to fair signal here in the East around 6-7:45 a.m. (when carrier of Australia's VLB comes on); uses mostly Chinese dialects, is scheduled to relay the BBC news from London at 6 a.m.

LKQ, 11.735, Fredrikstad, Norway, relaying Oslo, is verifying reports from Administration of Telegraphs, Radio Dept., Broadcast Division, Oslo, Norway (Norge). Is heard in New

York with a fair signal from 5:45 to about 7 a.m. fadeout. (Beck) LKJ, 9.540, Oslo, is heard with bad QRM in Sweden at 1:35 p.m.; on about 6.180, Oslo is heard between 4-4:15 p.m. (N. Johnsson) The Oslo transmitter on about 6.180 is heard in New York signing off at 5 p.m. (Beck) Also heard in Sweden around 12:30 p.m. (B. Nilsson)

Radio Dakar, Fr. West Africa, listed on 15:345 but now operating on about 15.388, is being heard widely from 1:30-5 p.m. daily, sometimes longer; has especially good signals in the East. Strong signals are still being heard from this station on its 11.712 frequency, 2:15-2:30 a.m.

Acknowledgements

In order to provide more space for "Last Minute Tips," individual acknowledgements are being omitted. Our sincere thanks go to each person who contributed to the ISW Department this month. For location of reporters credited with individual items herein, please refer to "Acknowledgements" in previous issues.

—30—

Sonar—Sub's Nemesis

(*Continued from page* 49)

both the receiver and the driver with one control, and adjustment of both to the resonant frequency of the projector is greatly simplified.

In the *Submarine Signal Company's* WCA-2 equipment, often used on submarines, part of the h.f. oscillator voltage is fed to the driver amplifier, where it is mixed with a frequency generated by another oscillator tuned to the i.f. of the receiver, as shown in the block diagram of Fig. 6. In this equipment, the operator can tune both the receiver and oscillator simultaneously, as in the QCQ-2, but the driver amplifier for the WCA-2 equipment is generally installed in another part of the ship from the receiver and indicator stack.

Since the sound beam from the projector is highly directive, having a width of about 20 degrees, it is possible to use it as an indication of the bearing of the target. Even with a beam of this width, it is necessary to define the edges of the target by determining the "cut-on" points, as shown in Fig. 4. The midpoint between the cut-on points is then considered the bearing of the target.

A synchro system actuates a motor control circuit, such as an amplidyne, to direct the sound beam to any desired bearing. The operator turns a hand wheel which rotates a synchro generator. Another synchro is geared to the training motor. One of the rotors is supplied with 115-volt, 60-cycle, a.c., while the other is connected to the amplidyne amplifier. When the two rotors are 90 degrees apart electrically, no voltage is induced in the second one. When the control synchro is turned by the operator, the

Front view of WCA-2 "stack."

voltage induced in the rotor of the second synchro is applied through a transformer to the grids of two tubes. The plates of these tubes are fed with a.c. The amplifier is essentially a grid controlled rectifier circuit, and the direction of rotation of the training motor is controlled by whichever tube is conducting. This explanation is considerably simplified, since the amplifier controls the amplidyne generator, which in turn furnishes armature current of the correct polarity for the desired rotation of the training motor armature. This type of control is used in much of the sonar equipment, the most common being the QCS, QCT, and QCQ-2 models. The *Western Electric* QBF employs a three-arm "potentiometer" device which supplies a.c. voltage of correct amplitude relationships to a large synchro training motor directly, thus simplifying the control circuits. The "potentiometer" is actually a transformer with the brushes making contact with the windings at the proper points to furnish the necessary motor voltages.

All of these systems employ a separate synchro link between the training gear and the operator's stack. This bearing indicator shows the projector bearing, with respect to the ship's heading, on a fixed scale, and the absolute bearing on another scale rotating in synchronism with the ship's gyro-compass system. The training panel for the QCQ-2 equipment is shown in Fig. 3.

So far we have described some of the equipment used for echo ranging of submerged objects in a horizontal direction from the ship. If, however, the projector were turned 90 degrees around a horizontal axis and directed downwards, the equipment could indicate the depth of the water below the ship. This is exactly what is done in echo sounding equipment. Since the projector used for sounding does not need to be rotated, it becomes a fixed unit mounted flush with the hull. In many such installations, one pro-

jector is used as the transmitting unit, and another is used for receiving. Simplified equipment of this type is in general use on all ships, some being equipped with continuous recorders, making a permanent record of the depth of the water as the ship pursues its course.

Sonar, like radar, is rapidly finding peacetime uses. Compact sounding equipment is being developed for even the smallest pleasure cruisers; powerful systems are capable of locating schools of fish for commercial fishermen; sunken ships can be located with sonar equipment; in one case, even, a sunken airplane was located in 160 feet of water at the bottom of a lake.

Numerous types of circuits are required to make a complete sonar system effective. In some models, a cathode-ray tube is used to indicate to the operator when he has the projector trained directly on a target, or when it is one or two degrees to the right or left. This equipment is known as the Bearing Deviation Indicator, and it is a great help to the operator in giving accurate target bearing to the conning officer. To make an effective attack, the target information must be obtained quickly and accurately; the bearing, course, and speed of a submarine must be known, and there can be no guesswork. How well sonar has done this is evidenced by the number of submarine sinkings—nine hundred and ninety-six submarines would make a formidable fleet for any country. But those, at least, will never fire another torpedo, thanks largely to sonar.

—30—

REPAIRING HINT

IN MANY of the older types of receivers you may be called upon to service, the ganged tuning condenser plates short out or scratch against each other causing the set to be dead or noisy. Sometimes no amount of mechanical "juggling" will separate the misaligned plates. The cause seems to be inconsistent plate spacing on the rotor shaft and/or the stator. The spacing usually is normal in the center but misaligned in opposite directions at one or both ends. The last resort seems to be one of bending plates—a bad practice and one which, if successful, is time consuming.

By disconnecting the coil from the bad section or sections and connecting a 6-volt storage battery across the section, the touching edges can be burnt with no damage to the condenser or the battery. However it is not a recommended procedure when the plates rub firmly together. Be sure and rotate the plates while the battery is connected so that too much burning will not occur.

To give more clearance and to prevent the job from "bouncing back" the rotor can be swung through its range a second time with a slight pressure against the spring.

If this procedure does not clear the plates, it will at least give a good indication where the plates are touching.

. . . . . A.M.P.

LETTERS from our readers

REQUEST GRANTED

"I MAKE a special point of mentioning RADIO NEWS magazine to new classes to encourage and stimulate interest in radio.

"Its over-all accuracy in diagrams and illustrations is remarkable, as I well realize errors can creep into any drawing and are not, always, very apparent.

"The request for more 'semi-technical' articles on test equipment is on behalf of large classes who besiege me during my spare time for such information.

"Your fine magazine has printed many good v.t.v.m. designs, but few have told how to use a meter of different sensitivity in the same circuit.

"A question that comes up repeatedly is how to design high resistance multiplier for vacuum tube voltmeters. I am sure an article on this information would interest thousands in the radio field who have the equipment but not quite enough 'know how.'"

George W. Kelly
Chicago, Illinois

We have long recognized the need for certain material designed for those new radio men who are daily joining the "fraternity." Now that the RADIO NEWS *staff is back to its prewar strength, we will be able to build, design, test and describe new equipment suitable for the beginning or intermediate radio man. This service will be furnished in a monthly department and should provide plenty of practical, easy-to-built equipment for our readers.*

* * *

SERVICE DATA

"I AM prompted by your recent editorial in the January issue about servicemen and service data to blow off a bit of long-pent up steam on the same subject. I have been in this somewhat bewildering business ever since 1928, and practically all of that period has been spent wondering if there wasn't something we could do about that same headache.

"This chronic condition has been aggravated by the 1946 and 1947 receivers. With everyone else I have had the troubles you mention with the new jobs. A goodly part of it, in my opinion, can be attributed to faulty engineering. I have seen cases of dial-drive design that could be improved on by a NRI graduate on his first set! I have long wished that all design engineers could be made to serve a year in the field, repairing some of their (or rather others') creations, before they were permitted to commit some of the atrocities they foist upon us. The rest of the trouble can be attributed to nothing but sloppy workmanship. If the average service shop put out the class of solder joints, etc. that are being found in quantities in the new receivers, they would be out of business in a month. This condition can, and definitely should be, corrected. The new receivers are a long way from coming up to past standards of material and workmanship.

"Having relieved myself of fifteen years' gripes, here are a few constructive suggestions.

"1. Paste in each cabinet a chart showing the location of various trimmers, especially for the multi-band sets. Leave out of service manuals, etc., the long alignment processes. Most reputable servicemen are familiar with this process. Better still, stamp trimmer numbers, etc., on the chassis by the holes.

"2. Make parts which need most frequent replacement more accessible. Filter condensers, coupling condensers, etc. are often buried beneath a mass of wiring, or even transformers, chokes, etc.

"3. Mark i.f. frequencies on transformer cans. This has been done by some manufacturers for years and I consider it a great help.

"4. Simplify some of the horribly complicated dial drive systems now in use. It seems to me the same result could be accomplished without the maze of pulleys, dingbats, etc. on some sets.

"5. Mark limits of pointer travel and alignment frequencies on backs of "blind" dial faces. In other words, when you take the set out of the cabinet and leave the dial scale in it, it is really aggravating to have to spend an unnecessary half-hour shoving the set in and out of the box to find out where you are on the scale.

"6. Make all speaker leads, phono pick-up leads, etc. plug into the chassis and leave the wiring on the speaker, etc. (Also the loop antenna leads.) This would make for much easier handling of the chassis after removal from the cabinet.

"Thanks for bearing with me thus far. I would like to see some more discussion on this subject, just to see what some of the other boys think about it.

Jack Darr
Ouachita Radio Service
Mena, Arkansas."

Well, what do the rest of you servicemen think about Mr. Darr's suggestions?

* * *

METAL LOCATORS

"I HAVE been a constant reader of RADIO NEWS for the last ten years or more. There have been very

few copies missed, even though most of them were purchased at local newsstands. Even during my stay in the service (44 months), some of the boys had the magazine mailed to the ship from the States.

"I was a Radio Tech in the Navy, having completed Navy schools in radio, radar, and sound gear. I finished my secondary at Navy Pier in Chicago.

"For a long time I have been interested in radio metal locators. With interest I have followed the two articles of recent months by Osborne.

"I am especially interested in the final article to appear, using radar methods, or pulsing. When will the article appear—or has publication been cancelled? It seems such a long time to wait—or am I impatient?

Carl Spiner Phyln
Misenheimer, North Carolina."

For Reader Phyln and the many others who have asked for more information on metal locators we have tentatively set another article on the subject for April.

—30—

Packaged Radio Service

(*Continued from page* 61)

would have no technical information on 3 out of every 10 receivers if he depended solely upon the manufacturer for service data and literature.

To fill this gap, engineers draw up a schematic diagram of every set for which no drawings are available before the set is processed. These are checked for accuracy and for the proper selection of replacements by direct comparison with those in the actual receiver. Many errors are uncovered in the process of analysis, either in the diagrams or parts lists. Careful tabulation shows that about 60% of all receivers analyzed are accompanied by data that is in error. Many reprint services or manuals which merely copy and reproduce the original manufacturer's diagrams and data will have the same high percentage of errors, as has been proven in thousands of cases. This has long been a plague to the serviceman.

To offset any possibilities of error, each piece of equipment received for processing is carefully unpacked and a series of photographs is made of the external cabinet. If any difficulty is encountered in removing the chassis from the cabinet, a disassembly instruction sheet is made up for inclusion in the folder covering that piece of equipment. It is a fact that many table models are much more difficult to disassemble than their big brothers, the consoles.

The next step is the taking of additional photographs of the top and bottom of the chassis. The technique employed has been worked out so as to assure the easiest identification of each component. After the set is processed through the disassembly line, two men re-draw and re-work the schematic diagrams and any necessary corrections are made. They cross-

check their findings against those provided by the analysts.

Another man devotes his full time to the identification and proper coding of each component shown on the pictorial diagrams or photographs. Thus it is possible to identify every item in the receiver from any or all of the following sources; the schematic diagrams, the parts list, and the pictorial diagram. Many "exploded view" diagrams are included. These are vital in the identification of parts used in complicated record changers, etc.

Data covering corrections, additions, and modifications on receivers made subsequent to their original production runs is published in the form of separate sheets and issued as such information becomes available.

Every effort is made to provide the radio serviceman with complete and accurate information when new receivers start coming into his shop. But there are additional problems of both a specialized and general nature which need to be solved. To answer these problems, and as a supplementary service to the *"Folders,"* the *Howard W. Sams Institute* has been established and it maintains a complete library of factory service literature, circuit diagrams, service hints and kinks that cover nearly every radio receiver ever manufactured in the U. S. This information is made available free to subscribers to the *"Photo-Fact Folder"* service.

New techniques were employed by the armed forces during the war to illustrate complicated mechanical and electrical equipment. No time could be wasted on old hunt-and-pick methods. No one can deny that a picture is worth a thousand words and not only do photographs explain the subject simply but an over-all picture is gleaned which makes for a more complete understanding of what makes the thing tick. We here at the Institute believe that the service provided by our organization is destined to streamline the profession of radio servicing.

—30—

OUTPUT TESTER FOR MICROPHONES AND PHONOGRAPH REPRODUCERS

FREQUENTLY it is desirable to know whether a microphone or a sound reproducer is satisfactory. Unfortunately this can not be done by a simple continuity test; however an equally simple test may be performed if one has a crystal earphone at his disposal. The method follows.

Disconnect the unit to be tested from the amplifier and connect to earphones. If the unit is a phonograph reproducer, place the pickup arm on a record and operate in the usual manner. When testing a microphone, a slight tapping on the microphone will serve as a sound source. If the tested unit is satisfactory, the reproduction in the phones will be of excellent quality, clear and distinct.

. . . . . **W. L. F.**

CHART OF WORLD TIME DIFFERENCES

Adjustments of local clocks to accord with the adoption or abandonment of daylight-saving time have now been made in most countries where the additional hour during summer-time is the rule, those in the northern hemisphere moving back an hour, those south of the equator an hour forward.

The chart below includes changes in clock-time up to and including October 31, 1946. Both the standard and current clock-time differences are given. The standard time of any area is governed, of course, by the local longitudinal difference from the Greenwich meridian, each 15 degrees of longitude equalling a time difference of *plus* one hour *east* of the meridian; *minus* one hour *west* of it. Adjustments of the standard variation to meet local convenience have been allowed for in the standard-time references below.

Area	Difference in hours from GMT Standard Time	Difference in hours from GMT Clock Time
ABYSSINIA	+ 2	+ 3
ADEN	+ 3	+ 3
ALASKA:		
(a) Ketchikan—Skagway	− 8	− 8
(b) Skagway—141 w. long.	− 9	− 9
(c) 141 w. long.—162 w. long.	−10	−10
(d) 162 w. long.—westernmost point	−11	−11
ALGERIA	GMT	GMT
ANGLO-EGYPTIAN SUDAN	+ 2	+ 2
ARGENTINA	− 4	− 3
AUSTRALIA:		
(a) Victoria, New South Wales, Queensland, Tasmania	+10	+10
(b) N. Territory, S. Australia	+ 9½	+ 9½
(c) W. Australia	+ 8	+ 8
AUSTRIA	+ 1	+ 1
BALI	+ 7½	+ 7½
BELGIAN CONGO	+ 1	+ 1
BELGIUM	GMT	+ 1
BERMUDA	− 4	− 4
BOLIVIA	− 4	− 4
BORNEO (British)	+ 7½	+ 7½
BORNEO (Dutch)	+ 7½	+ 7½
BORNEO (Islands East of and including Dutch Timor)	+ 7½	+ 8
BRAZIL:		
(a) East, including all Coast	− 3	− 3
(b) West	− 4	− 4
BRITISH GUIANA	− 3½	− 3½
BRITISH HONDURAS	− 6	− 6
BRITISH SOMALILAND	+ 3	+ 3
BULGARIA	+ 2	+ 2
BURMA	+ 6½	+ 6½
CANADA:		
(a) ATLANTIC ZONE: New Brunswick, Nova Scotia, Prince Edward Island, Quebec (East of Pied de Mont)	− 4	− 4
(b) EASTERN ZONE: North-West Territory (East), Ontario, Quebec (West of Pied de Mont)	− 5	− 5
(c) CENTRAL ZONE: Manitoba, North-West Territory (Central)	− 6	− 6
(d) MOUNTAIN ZONE: Alberta, North-West Territory (Mountain), Saskatchewan	− 7	− 7
(e) PACIFIC ZONE: British Columbia, North-West Territory (West)	− 8	− 8
CEYLON	+ 5½	+ 5½
CHILE	− 4	− 4
CHINA:		
(a) Manchuria	+ 9	+ 9
(b) 110 e. long. and 125 e. long.	+ 8	+ 8
(c) 95 e. long. and 110 e. long.	+ 7	+ 7
COLOMBIA	− 5	− 5
CYPRUS	+ 2	+ 2
CZECHOSLOVAKIA	+ 1	+ 1
DENMARK	+ 1	+ 1
DUTCH GUIANA	− 3½	− 3½
ECUADOR	− 5	− 5
EGYPT	+ 2	+ 2
FALKLAND ISLANDS	− 4	− 4
FIJI ISLANDS	+12	+12
FINLAND	+ 2	+ 2
FRANCE	GMT	+ 1
FRENCH CAMEROONS	+ 1	+ 1
FRENCH EQUATORIAL AFRICA (BRAZZAVILLE)	+ 1	+ 1
FRENCH GUIANA	− 4	− 4
FRENCH GUINEA	− 1	GMT
FRENCH INDO-CHINA	+ 7	+ 8
FRENCH WEST AFRICA:		
(a) Mauretania	− 1	− 1
(b) French Sudan	GMT	GMT
(c) Niger Territory	+ 1	+ 1
THE GAMBIA	− 1	GMT
GERMANY	+ 1	+ 1
GIBRALTAR	GMT	+ 1
GOLD COAST	GMT	GMT
GREECE	+ 2	+ 2
GREENLAND	− 3	− 3
GUATEMALA	− 6	− 6
HAWAIIAN ISLANDS	−10½	−10½
HOLLAND	GMT	+ 1
HONGKONG	+ 8	+ 9
HUNGARY	+ 1	+ 1
ICELAND	− 1	− 1
INDIA:		
(a) India generally	+ 5½	+ 5½
(b) Assam	+ 6½	+ 6½
(c) Bengal	+ 6½	+ 6½
IRAQ	+ 3	+ 3
ITALY	+ 1	+ 1
JAPAN	+ 9	+ 9
JAVA	+ 7½	+ 7½
KENYA	+ 2½	+ 3
LEBANON	+ 2	+ 2
LIBERIA	− ¼	− 1

Area	Difference in hours from GMT Standard Time	Difference in hours from GMT Clock Time
LIBYA:		
(a) Western	+ 1	+ 2
(b) Eastern	+ 1	+ 3
MADAGASCAR	+ 3	+ 3
MALAYA	+ 7½	+ 7½
MALTA	+ 1	+ 1
MAURITIUS	+ 4	+ 4
MEXICO CITY	− 7	− 6
MOROCCO (French)	GMT	GMT
MOROCCO (Spanish)	GMT	+ 1
MOZAMBIQUE	+ 2	+ 2
NATAL	+ 2	+ 2
NEWFOUNDLAND	− 3½	− 3½
NEW GUINEA (British)	+10	+10
NEW GUINEA (Dutch)	+ 9	+ 9
NEW ZEALAND	+12	+12
NICARAGUA	− 5½	− 6
NIGERIA	+ 1	+ 1
NORWAY	+ 1	+ 1
NYASALAND	+ 2	+ 2
PALESTINE	+ 2	+ 2
PANAMA CANAL ZONE	− 5	− 5
PARAGUAY	− 4	− 4
PERSIA	+ 3½	+ 3½
PERU	− 5	− 5
PHILIPPINE ISLANDS	+ 8	+ 8
POLAND	+ 1	+ 1
PORTUGAL	GMT	GMT
PORTUGUESE GUINEA	− 1	GMT
RHODESIA:		
(a) Northern	+ 2	+ 2
(b) Southern	+ 2	+ 2
RUMANIA	+ 2	+ 2
SAUDI ARABIA	+ 3	+ 3
SEYCHELLES	+ 4	+ 4
SHANGHAI	+ 8	+ 9
SIAM	+ 7	+ 7
SIERRA LEONE	− 1	GMT
SINGAPORE	+ 7½	+ 7½
SPAIN	GMT	+ 1
SPANISH GUINEA	GMT	+ ½
SUMATRA	+ 6½	+ 6½
SWEDEN	+ 1	+ 1
SWITZERLAND	+ 1	+ 1
SYRIA	+ 2	+ 2
TANGANYIKA	+ 2½	+ 3
TANGIER	GMT	+ 1
TRANSJORDAN	+ 2	+ 2
TRIPOLITANIA	+ 1	+ 1
TUNISIA	+ 1	+ 1
TURKEY	+ 2	+ 2
UGANDA	+ 2½	+ 3
UNION OF SOUTH AFRICA	+ 2	+ 2
U.S.S.R.:		
(a) Moscow	+ 2	+ 3
(b) Kuibyshev	+ 3	+ 4
(c) Transcaucasia	+ 3	+ 4
(d) Tashkent	+ 4	+ 5
(e) Tomsk	+ 5	+ 7
(f) Khabarovsk	+ 9	+10
UNITED STATES:		
(a) EASTERN ZONE: Connecticut, Delaware, Florida, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Vermont, Virginia, West Virginia	− 5	− 5
(b) CENTRAL ZONE: Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Tennessee, Texas, Wisconsin	− 6	− 6
(c) MOUNTAIN ZONE: Arizona, Colorado, Idaho, Montana, New Mexico, Utah, Wyoming	− 7	− 7
(d) PACIFIC ZONE: California, Nevada, Oregon, Washington State	− 8	− 8
URUGUAY	− 3½	− 3
VENEZUELA	− 4½	− 4½
WEST INDIES:		
(a) Bahamas	− 5	− 5
(b) Barbados	− 4	− 4
(c) Cuba	− 5	− 5
(d) Dominican Republic	− 5	− 5
(e) Haiti	− 5	− 5
(f) Jamaica	− 5	− 5
(g) Leeward Islands	− 4	− 4
(h) Martinique	− 4	− 4
(i) Nassau	− 5	− 5
(j) Puerto Rico	− 4	− 4
(k) St. Lucia	− 4	− 4
(l) St. Vincent	− 4	− 4
(m) Tobago	− 4	− 4
(n) Trinidad	− 4	− 4
(o) Turks Island	− 5	− 5
YUGOSLAVIA	+ 1	+ 1
ZANZIBAR	+ 2½	+ 3

Courtesy of "London Calling" magazine of the British Broadcasting Corp.

resonance curve to give us any desired compromise between selectivity and sideband response with the assurance that this compromise will hold unchanged for every station received. Furthermore, its constancy permits of judicious "faking" of the audio amplifier response to strengthen the high notes if we find that we cannot get the degree of selectivity we desire without undue cutting of sidebands in the i.f. tuned circuits.

5. It is possible to provide a choice of more than one over-all fidelity characteristic in a given receiver through the use of simple variable selectivity arrangements in the i.f. amplifier. This is especially important in high-fidelity AM receivers, communications type receivers, etc.

6. The i.f. fixed-tuned circuits are cheaper and occupy less space than would an equal number of variable-tuned signal-frequency circuits as there is no need for ganged variable tuning capacitors.

7. The absence of variable tuning capacitors reduces the possibility of widespread feedback occurring within the i.f. amplifier and makes preventive shielding of the circuits easier.

8. Since the total r.f. gain is obtained in amplifiers operating at two different frequencies, the possibility of over-all-feedback is reduced.

Image-Frequency Rejection

It will be remembered from previous discussions of the operation of the preselector that its main responsibility is to reject interfering signals of *image* frequency. Since the mixer will convert these to a frequency equal to the i.f. employed in the receiver, they will not be rejected by the tuned circuits of the i.f. amplifier. Consequently if they are to be rejected at all, the preselector, located ahead of the frequency converter, must do it.

Adjacent-Channel Selectivity

By adjacent-channel selectivity is meant the ability of the receiver to choose between the simultaneously received signals of the broadcasting stations operating on adjacent frequency channels. For American AM broadcasting stations, the usual frequency allocation of adjacent-channel stations is such that there is a 10 kc. separation between their carrier frequencies.

Let us consider the problem of selecting the signal of a 1000 kc. station from that of the adjacent-channel 1010 kc. station. The frequency difference between these two signals is 10 kc., or $10 \times 100/1000 = 1\%$. If a t.r.f. receiver were used for reception, this frequency difference would be maintained throughout the entire r.f. amplification system since both signals would progress through it unchanged in frequency. In order to obtain sufficient selectivity to select the desired signal from the interfering one, a cascaded series of t.r.f. amplifiers (all tunable) would have to be employed with the ultimate aim of achieving a cumulative resonance curve for the entire r.f. system that would be sharp enough to sufficiently attenuate the undesired signal 1% away in frequency so that it would not create annoying interference with the desired signal. This would necessitate the use of quite a number of tuned stages, each having its own variable tuning capacitor in the tuning gang. The resulting receiver would be quite bulky and costly.

If a superheterodyne receiver were used for the reception, it would have to meet the same selectivity requirement. The tuned circuits of the preselector provide some attenuation of adjacent-channel signals. However, the amount of adjacent-channel signal attenuation provided by the two tuned circuits in the usual 1-stage preselector would not be sufficient to completely eliminate interference from strong signals of such close frequencies. Fortunately, the very nature of the superheterodyne process makes a high degree of adjacent-channel selectivity inherent in the *i.f. amplifier*, and

the amount required may be obtained very largely by proper design of its tuning circuits and without reference to any other part of the receiver. Let us see why this is so.

How I.F. Amplifier Provides Adjacent-Channel Selectivity

Let us assume that the fixed-tuned circuits in the intermediate amplifier of the superheterodyne receiver employed in the preceding discussion are peaked at the now-standard i.f. of 455 kc. In the preselector circuits of the receiver there is a difference of 1010—1000 = 10 kc. = only 1% between the frequencies of the desired 1000 kc. signal and the interfering 1010 kc. adjacent-channel signal. If the selectivity of the preselector is insufficient to prevent the undesired 1010 kc. carrier from getting through rather strongly to the mixer, *both* signals will be acted upon by the 1455 kc. oscillator signal and the mixer and will have their carriers converted into carriers of lower frequencies, as illustrated in Fig. 2. Both frequency-converted signals will be present in the input of the i.f. system. The carrier of the *desired* signal will have a frequency of 1455—1000 = 455 kc. That of the interfering signal will have a frequency of 1455—1010 = 445 kc. It is evident that the frequency separation is still 10 kc., but the *percentage difference* is now 10 × 100/455, or approximately 2.2%. Therefore, while the original frequency difference is only 1%, it is approximately 2.2% after the two signals have undergone frequency conversion and reached the intermediate amplifier. Consequently the relative adjacent-channel selectivity problem in this case is approximately 2.2 times simpler for the i.f. circuit than for the t.r.f. preselector circuit of equal selectivity. In comparison it will be seen that an improvement of 2.2/1 = 2.2 times has been obtained from a selectivity standpoint by heterodyning the 1000 kc. wanted signal to 455 kc., with respect to adjacent-channel selectivity. The adjacent-channel selectivity of the i.f. amplifier is often called the *arithmetical selectivity.*

Effect of Signal Frequency on Selectivity of I.F. Amplifier

To determine the effect of signal frequency upon the adjacent-channel selectivity of both the r.f. preselector and the i.f. amplifier assume now that signals of higher frequencies—1500 kc. for the desired signal and a 1510 kc. for the undesired adjacent-channel signal —are applied to this same receiver. The frequency difference between these two carriers is still 10 kc. The percentage difference, however, is now 10 × 100/1500 = 0.66%, which means that the relative adjacent-channel selectivity problem is more difficult for the preselector now than it was in the case of a 1000 kc. signal.

However, after these two signals have been "converted" to the lower frequencies by the action of the 1955

kc. oscillator signal and the mixer, their frequencies will be 1955−1500 = 455 kc. and 1955 − 1510 = 445 kc. respectively. The percentage difference between these two frequencies is still 2.2%. It is evident that while the adjacent-channel selectivity of the preselector decreases with increase of signal frequency, that of the i.f. amplifier remains constant over the whole of the tuning range of the receiver.

In practice the decrease in selectivity of the preselector as the signal frequency increases is modified somewhat by the fact that it is usually possible to obtain higher values of Q at high frequencies than at low, so that the selectivity does not fall off as rapidly as one might expect as the signal frequency is raised. Nevertheless the fact remains that the higher the operating frequency the lower the adjacent-channel selectivity of the preselector. It will be remembered that trouble due to adjacent-channel interference in the old t.r.f. receivers occurred mostly at the high-frequency end of the band!

As most of the adjacent-channel selectivity in practical superheterodynes is obtained in the i.f. amplifier, it is substantially independent of the signal frequency and, ignoring the effect of the preselector circuits, the rejection of an adjacent-channel interfering signal is just as good at one end of the tuning band as it is at the other. This is a definite advantage of the superheterodyne receiver. The second great advantage is that since the i.f. circuits employ fixed-tuning we can use as many as are necessary to provide adequate selectivity and gain without complicating the signal-tuning operation of the receiver or making it unduly expensive.

I.F. Peak	Freq. of wanted signal (after conversion)	Freq. of interfering signal (after conversion)	% Freq. difference between wanted and interfering signals (after conversion)
100 kc.	100 kc.	90 kc.	10%
130 kc.	130 kc.	120 kc.	7.7%
175 kc.	175 kc.	165 kc.	5.7%
260 kc.	260 kc.	250 kc.	3.9%
455 kc.	455 kc.	445 kc.	2.2%
600 kc.	600 kc.	590 kc.	1.66%

Chart shows the effect of i.f. peak value on the per-cent frequency difference between wanted and interfering signals. The greater this percentage difference in frequency the more easily the two signals will be separated and the unwanted signal attenuated in the i.f. tuning system of the superheterodyne receiver.

How I.F. Value Employed Affects Selectivity of I.F. Amplifier

While we are on the subject of adjacent-channel selectivity of the i.f. amplifier it will be well to investigate how it is affected by the value of i.f. employed in the receiver. This was an important consideration affecting the standardization of receiver i.f.'s by the RMA a few years ago.

In order to determine the effect of the i.f. value employed in the receiver upon the adjacent-channel selectivity of the i.f. amplifier it will only be necessary to calculate the per-cent frequency difference that results, after frequency conversion, in a receiver to which a wanted 1000 kc. signal and an interfering 1010 kc. signal are applied and which employs the following successive values of i.f.—100 kc., 130 kc., 175 kc., 260 kc., 455 kc., and 600 kc.[2] The results are tabulated above and illustrated graphically in Fig. 3. It is apparent that the lower the i.f. employed in the receiver the *greater* will be the arithmetical selectivity advantage, or the percentage frequency separation of wanted and interfering adjacent-channel signals after the frequency conversion has taken place. The greater this percentage difference in frequency the more easily the two signals will be separated and the unwanted signal attenuated in the i.f.

[2] These are some of the i.f. peaks that have been employed in AM broadcast-band superhet receivers during the past fifteen years—before the standardization of i.f. peaks by the RMA.

If this were the only factor involved, it would appear to be advantageous to employ as low a value of i.f. as possible in a superheterodyne. However, several other important conflicting considerations (for example that of image interference) enter into the selection of the i.f. to be employed and place a definite, practical limit on how low it may be made. We shall learn more about this in the next lesson of this series.

(To be continued)

1N34 Discriminator

(*Continued from page* 55)

plus equipment stocks. These are less expensive than the units described and have been found to work equally well. The wiring of these units is the same as for the 1N35 and 1N34.

Fig. 4 shows a Summerhays discriminator which differs from the more

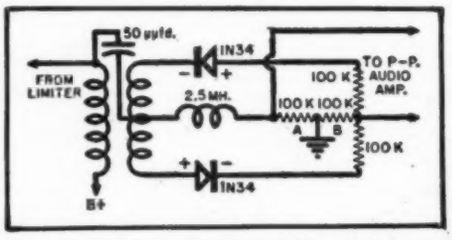


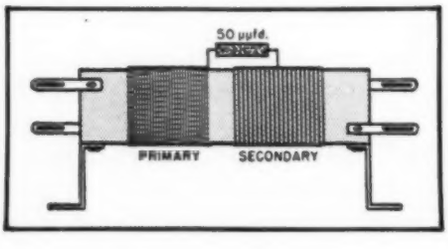
Fig. 4. Circuit diagram of Summerhays discriminator applied to push-pull grids. This arrangement delivers greater output than the Foster-Seeley circuit shown in Fig. 2. For single-ended operation output may be taken across A or B.

familiar Foster-Seely discriminator in that the two rectifiers are wired to provide rectification in opposite polarities. Two advantages of this type of discriminator are that it can be readily fed to a push-pull amplifier as shown in Fig. 4, and the output, whether single ended or push-pull exceeds that of the Foster-Seely. Another advantage is that where a center frequency indicator for tuning purposes is desired the Summerhays system delivers more current and therefore a less sensitive meter can be used without d.c. amplification. Amateurs should find this circuit and the others described in this paper very effective for inclusion in receivers for reception of amateur FM transmissions.

It should be mentioned in passing that the 1N34 functions equally well when used as a detector for AM, either in domestic or communications receivers.

—30—

Fig. 5. Conversion of i.f. transformer to a discriminator transformer.



Phone stations can also be received by tuning the receiver to zero beat with the incoming signal. For reception of code stations, the receiver can be left in an oscillating condition. Oscillation is indicated by a hissing sound in the speaker or the phones or by a click when the finger is touched to the stator plates of the tuning condenser. If there is no apparent click, the set is not oscillating.

Both the stability and the sensitivity of the set will be found to be good. The quality of voice signals compares favorably with commercial sets, if the volume is kept low. The speaker is not designed to carry too much audio output. Only a short antenna is required but one as long and as high as possible should be used for maximum results. A good ground is almost an essential. A connection to a waterpipe or to a bar of metal buried a couple of feet below the earth's surface will do well. The entire set, including tubes and miscellaneous components, can be built for about eight dollars.

-30-

Spot Radio News

(*Continued from page 22*)

will have a fair opportunity to compete." The committee requested that a "most favored nation" clause be included in all agreements. Good exports mean jobs to "a large number" of U. S. workers, RMA pointed out, adding: "Because of our large industry and mass production, we in the United States are in a position to appropriate large sums of money for engineering and research and thus have for many years been world leaders in radio engineering and in the development and manufacture of radio transmitters, sets, parts and tubes. Because of the superiority of the American product, many people in foreign countries prefer American-made radio equipment. We enjoy a unique position and are desirous of retaining this leadership. . . . Involved in the reciprocal trade negotiations this spring are: Australia, Belgium, Brazil, Canada, Chile, China, Cuba, Czechoslovakia, France, India, Lebanon, Luxembourg, Netherlands, New Zealand, Norway, Union of South Africa, Russia, United Kingdom, and the colonies of all of these nations.

PRODUCTION in this country, untrammeled by OPA controls, continues to boom. Latest RMA concensus points toward a total of from 12,000,000 to 20,000,000 sets before year's end. Minimum estimates among RMA members average 13,400,000 sets; maximum, 18,000,000. . . . RMA also reports that television receiver production is increasing steadily, usually breaking a record each month. Radio receiving tube output is hitting new peaks. . . .

-30-

Within the INDUSTRY

M. MARKOWITZ was recently named vice-president in charge of manufacturing by the board of directors of *Air King Radio Products Company, Inc.*, manufacturers of the *Air King* line of radios and radio-phonograph combinations.

Mr. Markowitz has been associated with the company for the past twenty years, during which time he served in many capacities with the *Air King* organization. His experience in the purchasing, fabrication of materials and mass production fields will be fully utilized in his new position.

* * *

FEDERAL TELEPHONE AND RADIO CORPORATION has announced that eighteen FM transmitters have been built and shipped by the company in recent months.

Stations soon to begin operating with this equipment represent 12 states bounded by New York and Minnesota on the north and Texas and Florida on the south. Most of these installations are of the 3 kw. type although some stations will go on the air with the company's 10 kw. units.

* * *

JOHN J. WILD, formerly associated with the *Television Equipment Sales Section* of *General Electric Company* as assistant sales manager, was recently named sales manager for the *Potter Instrument Company* of Flushing, New York.

Mr. Wild, who is a graduate of Georgia Tech, will be in charge of the merchandising of the company's line of electronic counting, timing, and industrial control equipment.

* * *

GEORGE T. DEANEY has been named purchasing agent of the *Weston Electrical Instrument Corporation* of Newark, New Jersey, succeeding A. R. Briggs, who recently retired after 45 years' service with the company.

Mr. Deaney joined the *Weston* organization in 1926 under its cooperative plan of industrial engineering training. He completed this training in 1928, the same year he received his B.S. in Electrical Engineering from Newark College of Engineering.

During his 18 years with the company, Mr. Deaney has worked as a time study engineer, department foreman, and cost estimator. His most recent position was that of department head in charge of mechanical engineering.

* * *

ELECTRONIC APPARATUS, INC. of New York has recently acquired the controlling interest in *Tuck Electronic Corporation* of Jersey City, N. J.

G. Emerson Pray, senior engineer and director of *Tuck Electronic Corporation*, was elected president of that company and also named director and vice-president of the parent company.

The new subsidiary of *Electronic Apparatus* will continue to maintain its operations at the Jersey City plant where the company manufactures, designs, and develops specialized industrial and electronic testing apparatus.

* * *

LOUIS S. KIMBALL has been recently named vice-president in charge of operations for the *Colonial Radio Corporation*, manufacturers of private brand radio receivers.

In his new position, Mr. Kimball will make his headquarters at the main plant, Buffalo, New York but will also have charge of the company's operations at the Bloomington, Illinois and Riverside, California factories.

Mr. Kimball has been associated with *Sylvania*, parent company of *Colonial*, since 1942 when he joined the organization as manager of the Fluorescent Fixture plant. He was later promoted to the post of general manager of the Fixture Division in 1945. He was connected with *General Motors'* Frigidaire Division for sixteen years prior to joining *Sylvania*.

* * *

WILLIAM F. COTTER has been appointed chief engineer of *Scott Radio Laboratories, Inc.* of Chicago.

Mr. Cotter has long been associated with the radio engineering field, having played an important role in the development of point-to-point duplex telephone, ship-to-shore telephone systems, police radio communications systems, and home receivers.

He has been associated with *Stromberg Carlson, American Bosch Magneto Company*, and *Federal Telephone and Telegraph Company* of Buffalo, New York. He is a member of several professional engineering societies and holds executive positions with the A.I.E.E., I.R.E. the Radio Manufacturers Association and the Radio Technical Planning Board.

Mr. Cotter succeeds Marvin Hobbs, former chief engineer with the company, who resigned to engage in consulting engineering on radio broadcast equipment.

* * *

DONALD T. McCOY will cover the Ohio sales territory for the *Belden Manufacturing Company* of Chicago, manufacturers of cable and wire.

Included in the lines that Mr. McCoy will handle are *Belden's* automotive, radio, arc welding, cable and neon sign equipment. Mr. McCoy is a recent graduate of the company's sales training and expansion program. He was discharged from the Army last April with the rank of 1st Lieutenant in the Corps of Engineers. His formal educational training was completed at Marmion Military Academy, Aurora, Illinois.

* * *

JACK E. SNYDER is the new manager of the export division of *Concord Radio Corporation* of Chicago. He will supervise the extension of the company's service to the radio and electronics industry throughout the world.

Mr. Snyder has been associated with *Concord* for the past sixteen years.

* * *

WILLIAM MAC MURTRIE has been appointed to the post of General Purchasing agent of the *Philco Corporation*.

He has been associated with the company since 1935 when he joined the purchasing department. In 1938 he was placed in charge of the Chicago office of the company's purchasing department and later became divisional purchasing agent for the automobile radio division with offices in Detroit.

His promotion to assistant general purchasing agent came three years ago, during which time he was a key figure in handling the production of airborne radar equipment for the Army and Navy.

* * *

PYRAMID ELECTRIC COMPANY of Jersey City, New Jersey, has recently acquired a 30,000 square foot, single story plant at Paterson, New Jersey, to handle increased production of dry electrolytics, as well as several types

ANSWERS TO BIZ QUIZ

1. a	6. c	11. a	16. a
2. c	7. a	12. c	17. c
3. a	8. b	13. c	18. c
4. c	9. a	14. a	19. c
5. b	10. a	15. c	20. a

ARE YOU A SALESMAN? Give yourself 5 points for each answer you had checked correctly. A score of 45 is average, and 75 or better is very good indeed.

of condensers which are expected to be added to the company's line in the near future.

The general offices of the company will remain at the main plant located in Jersey City, New Jersey.

* * *

WALTER E. HARVEY has joined *P. R. Mallory & Co., Inc.* of Indianapolis as manager of the Wholesale Division.

Mr. Harvey has been placed in charge of distribution and merchandising of the company's line of radio and electronic replacement parts.

He has been long associated with the wholesale jobbing trade, having been connected with *Thermoid Company*, manufacturers of automotive and industrial rubber products. He has also held executive posts in several national trade associations.

* * *

KINGS ELECTRONICS CO. of Brooklyn, New York has recently announced a new service to manufacturers of television equipment.

The company, manufacturers of television antennas, variable condensers, coaxial cable connectors, microphone plugs, and jacks, is making available the services of its television engineering staff to assist manufacturers with their special television and FM antenna requirements.

Companies who wish to avail themselves of this service are asked to contact J. H. Robinson, vice-president, *Kings Electronics Co.*, 372 Classon Avenue, Brooklyn 5, New York.

* * *

ALFRED T. JOHNS is the new production manager of *Lear, Incorporated's* Home Radio Division.

With seventeen years' in the radio industry, thirteen of which were with *Sparks Withington Company*, three with *International Detrola* and a year with *John Meck Industries*, Mr. Johns brings to his new position a wealth of experience in production methods.

* * *

KENNETH A. NORTON has been named chief of the newly established Frequency Utilization Research Section of the Central Radio Propagation Laboratory at the National Bureau of Standards.

Mr. Norton, who is an authority on radio wave propagation, rejoins the Bureau's staff from the War Department where he served during the war as a consultant on radio propagation to the Chief Signal Officer and as assistant director the Dr. W. E. Everitt's Operation Research Group.

He will direct the activities of this new section which was activated to investigate the utility, for specific ap-

plications, of various portions of the radio frequency spectrum. He has been associated with the Bureau of Standards intermittently since 1929, having been granted leaves of absence to serve with the FCC and the War Department.

-30-

Sound Recording

(*Continued from page* 92)

harmonics of a fundamental tone are generated at different intensity levels. This may be compared in a sense to higher resonant modes of a vibrating mechanical system and their general effect is to reduce fidelity of the original tone.

There is a definite phase effect existing between the sound wave and generated harmonics in the ear and the effect contributes to the distortion experienced in hearing. As may be expected, there are definite intensity limits between which speech and music are reproduced with perfect fidelity.

There are many factors affecting the quality of a tone. Among these are the harmonic content, pitch, and intensity. The *quality* of a tone is also called *timbre* and should be distinguished from *fidelity*. Timbre is a relative quality of sound while fidelity is a true measure of the accuracy with which a sound is reproduced. While much has been done in measuring timbre, the results are subjective. "Fullness," "richness," "brassy," "metallic," are some of the terms used in describing the timbre of a sound.

(*To be continued*)

What's New in Radio

(*Continued from page* 78)

50 db. below 1 volt dyne/ cm^2 open circuit.

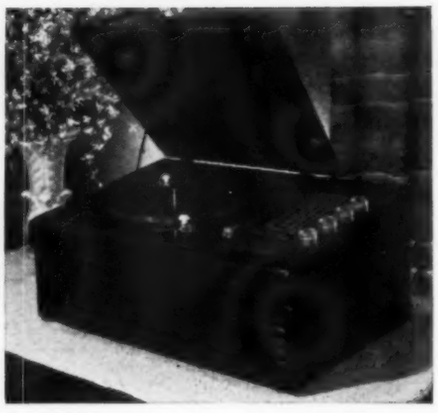
Designed in an attractive combination of black molded plastic and satin chrome finish, this high impedance unit can be used with any amplifier or recorder employing high impedance input. The microphone is supplied complete with an 8 foot cable, plug and removable base which allows conversion from a desk to hand mike at will.

The Brush Development Company, 3405 Perkins Avenue, Cleveland 14, Ohio will supply additional data to those who ask for it.

COMBINATION RADIO

Air King Products Company, Inc. has recently introduced its new table model radio-phonograph combination, "The Crown Princess," to the trade.

Designated as the Model 4704, this unit is styled with simple dignity which fits into any decorative scheme, modern or period. This model comes in satin walnut finish accented by an edge-lighted dial, and features an automatic record changer for ten and twelve inch records, a featherweight low-pressure tone arm, permanent



needle, crystal pickup, a.v.c., full range tone control and built-in aerial.

The company will gladly furnish information on this, and other units in the line to those writing *Air King Products Company, Inc.*, 1523 Sixty-third Street, Brooklyn 19, New York.

—30—

Transmitter-Exciter
(*Continued from page* 39)

value of fixed capacitance which must be shunted across the coil so as to cover the frequency range of 1750 to 2000 kilocycles. From this example we may derive the general relation, $C = \Delta C/(f_r^2 - 1)$ where ΔC is the variation in tuning capacity (maximum minus minimum capacity of tuning condenser) and f_r^2 is the square of the highest frequency divided by the square of the lowest frequency.

A popular misconception regarding e.c.o.'s is that the position of the cathode-tap affects the drift. While the cathode tap adjustment does have an effect on the frequency vs. supply voltage characteristic and may thereby cause chirpy keying, it does not affect the drift characteristic. This drift, usually evidenced by a gradual change in frequency toward lower frequency as the oscillator warms up, is almost entirely due to temperature, humidity, and other random variations affecting the physical characteristics of the oscillator components, principally the tuning condenser and coil form. In attacking drift, therefore, we must attempt to eliminate these variations. In ordinary amateur construction there is little control over humidity variations, but changes of the ambient temperature inside the oscillator compartment may be reduced to negligible proportions. Cyclic heating of the oscillator components does not produce exact reproduction of components because of the poor retrace characteristics of most of our insulating materials and for this reason it is more practical to eliminate temperature variations rather than attempt to stabilize the temperature of the oscillator compartment at some value which must necessarily be higher than the highest value of the ambient temperature.

Practically all the heat in the oscillator compartment has the tube as its

source. Tube heating is made up of the heater and plate and screen grid dissipations. The 6F6, popular as an e.c.o., is a serious offender from the standpoint of heater dissipation since it has a .7 amp. heater which, even in the absence of plate dissipation, heats the envelope enough to make it uncomfortable to touch. One of the best e.c.o. tubes from the standpoint of reduced heat dissipation (and for several other reasons) is the 9001. Compared to the 6F6, the 9001 with its 150 ma. heater represents a 450% reduction in heat dissipation. In the transmitter described, the less expensive 6SJ7 was used as oscillator, operating the heater at three volts. At this voltage the heater current is considerably under 300 ma. and the reduction in heat, again compared to the 6F6, is over 500%. The tube envelope barely becomes warm to the touch.

Plate dissipation is the other major item to be reduced. The literature available on the subject emphasizes that low-power input to a self-controlled oscillator results in improved stability. However, low power to many amateurs means anything under five watts, which is enough to heat the oscillator compartment to a considerable extent. In the transmitter described herein, the combined plate and screen grid input is .09 watt, (90 volts at 1 ma.), or about 10% of the heater power dissipation. Needless to say, the heating is negligible. Tests have shown the oscillator to be re-

WHAT PRICE GOOD WILL?

WITHOUT his knowing it, every salesman is building something into the warp and woof of his life that is worth more than the dollars and cents he takes each year from his efforts.

The name of this something is good will.

Good will is another name for the number and intensity of the business friendships a salesman is able to build for himself—and keep.

A good many attempts to put a value on good will have been made, but the clearest was published in the newspapers a few years ago when a firm of investment bankers bought the automobile business of the Dodge Brothers.

The amount paid for that business was 170 million dollars—all cash. The physical assets of the Dodge concern amounted to little more than half that—100 million dollars. But here were hardheaded New York bankers paying 70 million dollars for what?

For good will. For two words—Dodge Brothers. And they considered it a very great bargain.

It was. For good will is a constant asset. Plants can burn down, physical assets can be dissipated, but if a man or a firm has good will, he has the only thing in business which has a constant and growing value.

Take care of your good will and your good will will take good care of you.

That sentence sounds as if repeater Gertrude Stein had written it, but it is good selling if not good language.

80 & 40 Meters

L_1, L_2 1750-2000 kc., 19 t. #26 d.c.c., diam. 1¼", winding length, ⅝". Sec. 5 t. #26 d.c.c. interwound at gnd. end of grid coil.

L_3 3500-4000 kc., 19 t. #22 d.c.c., diam. 1¼", winding length, ⅝".

L_4 80-40 meters, 19 t. #22 d.c.c., diam. 1½", winding length, ¾".

40 & 20 Meters

L_1, L_2 3500-4000 kc., 10½ t. #22 d.c.c., diam. 1¼", winding length, ⅝". Sec. 3 t. #22 d.c.c. interwound at gnd. end of grid coil.

L_3 7000-7300 kc., 14 t. #24 d.c.c., diam. 1¼", winding length, ⅝".

L_4 40-20 meters, 10 t. #22 d.c.c., diam. 1½", winding length, ¾".

Details for constructing coils for 20, 40, 80 meter operation.

markably stable, holding zero-beat with commercial stations at 7.5 mc. for hours at a time after a warm-up period only long enough to allow the tube heater to arrive at a stable temperature. Since the heater voltage is reduced, the warm-up time required to bring the tube to operating temperature is slightly longer than would be necessary with 6 volt operation but does not exceed one minute.

As a further commentary on the cathode-tap adjustment, tests showed no difference in performance from the value of feedback which would barely sustain oscillation to that value which caused squegging. The voltage regulator tube gives better than .5% regulation of the oscillator supply voltage because of the low oscillator current drain. Since the voltage is so well regulated, the cathode-tap has no chance to cause chirpy keying.

The oscillator is followed by a 6AG7 biased to class "A" operating conditions. The 6AG7 combines the high gain characteristics of the television series such as the 1852 with the high plate dissipation rating of the 6V6. Since it is well-screened, it affords additional isolation of the oscillator from the higher level stages. A 6L6, 6V6, or 6F6 may be used in the doubler stage with practically the same results. This stage is tuned to twice the e.c.o. frequency.

Careful attention to short leads and adequate bypassing will pay dividends in freedom from parasitic oscillations and spurious coupling between stages. Mica bypass condensers were found to be insufficient and were replaced with higher capacity (and cheaper) paper condensers which completely cured all parasitic troubles.

The 807 final amplifier stage has a combination of fixed and grid leak bias for oscillator keying. The 807 may also be keyed, and in this type of operation the fixed bias is not used, resulting in somewhat more output. Power input is approximately 43 watts with oscillator keying and 54 watts with final amplifier keying. A switch is provided in the 807 cathode lead to permit frequency setting of

the e.c.o. without QRM to other stations. With a 140 $\mu\mu$fd. tank condenser both the 40 and 80 meter bands may be covered with one plate coil. The 807 operates as a frequency-doubler for 40 meter output but the output is almost as great as in straight-through operation. The tank coil socket is mounted on spacers above the chassis so that the leads to the coil will be out of the proximity of the 807 grid circuit. There is no reaction on the frequency as the 807 tank circuit is tuned through resonance.

The power supply is conventional, using condenser input to obtain approximately 500 volts for the 807. The total drain from the power supply with the 807 loaded is 170 ma. With a 12 μfd. input condenser the output is T9. The fact that the 807 plate and screen current does not flow through the filter choke actually aids the filtering since the choke is not saturated with d.c. Also, there is a phase difference in the ripple voltages applied to the 807 output and input circuits which tends to cancel the hum in the carrier. This transmitter was used quite successfully on phone with many complimentary reports.

—30—

20 Watt Modulator

(*Continued from page* 51)

versally applicable, as is, to cathode modulation. Output windings of the transformer shown will handle 200 ma. d.c.

For modulating "inflexible" u.h.f. rigs, the 500-ohm output of the modulator might be applied to the 500-ohm primary of a multimatch modulation transformer such as *Stancor* A-3834 or A-3866.

An individual builder may prefer to use another type of output transformer in the T_2 position to give a variety of output impedances. This is permissible. The plate-to-plate impedance of the primary will have to be 9000 ohms, and the secondary should be capable of carrying 200 milliamperes d.c.

The two relay contacts in series with the high-voltage center tap of power transformer T_3 may be connected to terminals of the transmit-receive relay in the transmitter. This will allow the modulator to be switched off automatically during reception periods without extinguishing the tube heaters. If relay control is not desired, the relay contacts may be omitted or may be connected together temporarily by means of a short jumper wire.

Mechanical Details and Wiring

The modulator is built on a 17" x 8" x 2" metal chassis. A 17" x 8" x 5" ventilated metal cover fits over the top of the unit and is secured to the left and right ends of the chassis by means of self-tapping screws. This cover was removed for the photographs, Figs. 1, 2, and 4.

All parts must be secured firmly to the chassis before wiring is started. 10-32 screws are used to mount the transformers and filter choke. Liberal use is made of lock washers.

In each of the first two amplifiers stages, it is imperative that all ground returns be run to *one* grounded lug. This common lug preferably should be located at a central point. This perhaps does not make the neatest appearing arrangement, but it is the most efficient electrical assembly of a high-gain audio stage. Such common ground connections in the various stages should be connected together by means of a length of heavy bus wire. The chassis must not be depended upon as a return conductor.

Leads between jack *J*, radio-frequency choke RFC_1, and the control grid terminal of the 6SJ7 socket must be enclosed in shield braid and the braid must be connected to chassis at each end of its length.

A tightly-twisted pair made of heavy hookup wire must be run between the heater terminals of the amplifier tube sockets and the 6.3-volt winding of transformer T_3. This line must be kept close to the chassis. One side of the heater line must be grounded to chassis at one point (preferably at the power transformer), but under no circumstances should the chassis itself be employed as one leg of the heater circuit.

In Figs. 2 and 4, the chassis receptacle for the 115-volt line plug may be seen along the rear lip of the chassis. This is a handy attachment, since it permits complete removal of the line cord-plug assembly. It is an added refinement, however, and may be omitted if cost is to be kept down or space conserved.

From left to right along the front lip of the chassis (See Fig. 1), are mounted the microphone jack (*J*), gain control (R_6), on-off line switch (S_1), and pilot light (*PL*). In Fig. 1, the microphone plug is shown inserted into the input jack. Each of these components is mounted as close as possible to the rest of the circuit with which it is associated.

The hole seen on top of the chassis between the third metal tube and the electrolytic capacitor, in Fig. 1, was intended originally for leads to a volume level meter on the front of the dust cover. After several tests, however, this meter was finally dispensed with.

In order to prevent core vibration, all assembly screws and nuts in the transformers and choke must be tightened carefully before these components are mounted on the chassis. It is not uncommon for these screws to loosen in shipment.

Before the final mounting is completed, the core of the filter choke must be set in the direction which results in the least hum pickup by the first amplifier stages. The correct direction must be determined experimentally by rotating the choke while listening to the hum in a speaker connected to the modulator output terminals. Thus, the entire modulator must have been wired and in working condition before this test can be made. The mounting of transformers and choke shown in Figs. 1 and 5 was found to be the best arrangement for components of the make and type specified. If an individual builder uses these same parts, he may follow the indicated layout to the letter.

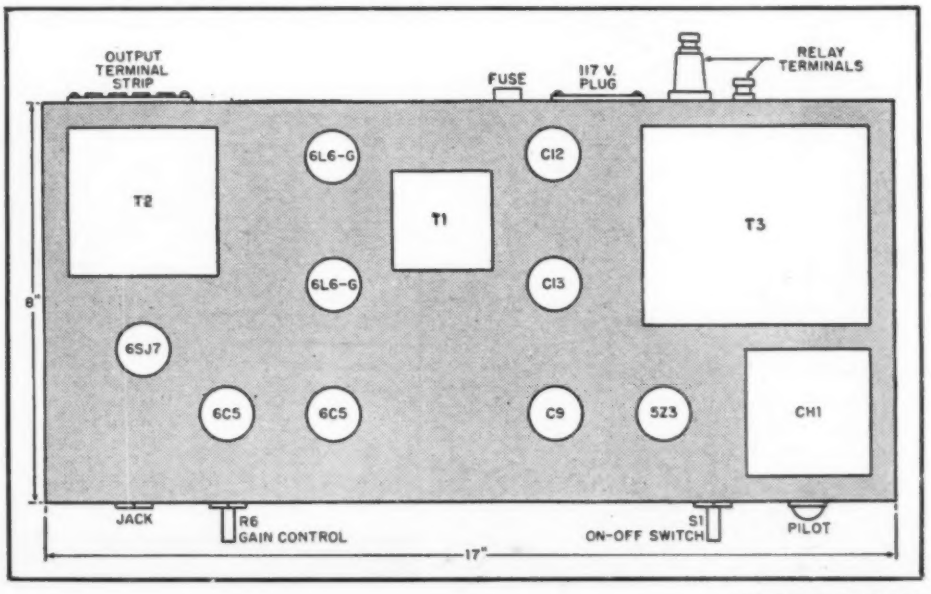
In wiring the modulator, long leads are to be avoided in all stages. Each component must be placed as close as physically possible to other components to which it is to be connected. Grid and plate leads must be kept far enough apart to prevent undesired feedback coupling.

Testing

Because of the straightforward nature of the modulator, no adjustments or elaborate tests are necessary to place the unit into operation.

After assembly and wiring have been completed and have passed inspection, the modulator may be

Fig. 5. Mechanical layout of chassis showing relative location of parts.



checked by connecting a speaker with 500-ohm input to the 500-ohm output terminals of the unit, and switching on the power. With the gain control "wide open," both hum and hiss should be negligible and there should be no whistles, squeals, or motor-boating. *Do not use headphones for this test.*

An audio-frequency signal of 1 millivolt or less fed into the input jack, *J*, from a low-distortion audio oscillator, should give a strong, clear signal in the speaker. Effectiveness of the gain control may be checked while this signal is passing through the amplifier by swinging potentiometer R_6 through its entire range. If blocking or plugging of the signal occur near the maximum volume setting of R_6, reduce the signal from the oscillator.

If d.c. voltage measurements are to be made at the socket terminals, use a voltmeter with very high input resistance, preferably an electronic type such as the *VoltOhmyst Jr.* or *Vomax*. Test meters with a sensitivity rating of 1000 ohms per volt or less will give erroneous readings.

Some advantages may be realized by matching the 6L6 tubes used in the output stage. A simple plate and screen current test usually will be sufficient and the easiest one for most amateurs to make, although a matching of transconductances would be much better. It is not imperative, however, that these tubes be matched.

—30—

3" Oscilloscope

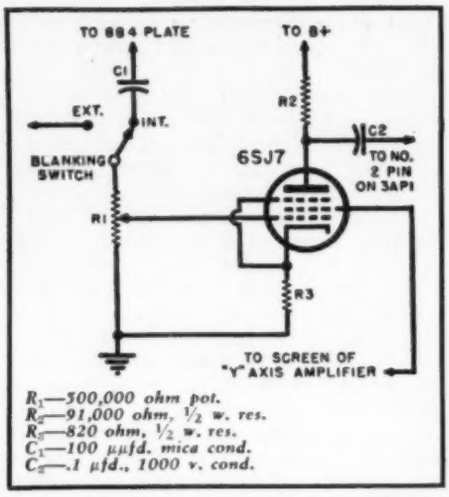
(*Continued from page* 70)

out of tubes and parts. The focus, intensity, and two centering posts are brought to the front panel through flexible insulated couplings, panel bushings and extension shafts. Be sure to insulate the resistors in the high voltage bleeder circuit properly. The circuit diagram is shown in Fig. 1.

The finished scope should be enclosed in a metal cabinet so that the unit will be electrostatically and magnetically shielded. The exact size and shape will depend on the size and shape of the chassis you use.

When the unit is finished, turn it on and you should observe a trace on the tube provided all the switches are turned to internal position, the sweep amplitude control is advanced, and the sweep frequency switch is set to any of the frequency ranges. Adjust the focus and intensity controls until the trace is sharp and bright enough to be easily observed. The trace or spot should not be left motionless when it is bright, as it will burn the screen.

Connect the *Y* axis input to the 60 cycle output on the front of the scope and adjust the controls until you become familiar with their operation. In some cases, it may be necessary to ground the scope to a water pipe by means of the ground binding post at the bottom of the front panel.



R_1—300,000 ohm pot.
R_2—91,000 ohm, ½ w. res.
R_3—820 ohm, ½ w. res.
C_1—100 μμfd. mica cond.
C_2—.1 μfd., 1000 v. cond.

Fig. 7. Circuit diagram of Z axis amplifier. This unit can be incorporated as an additional feature of cathode-ray oscilloscope.

Let us now measure an unknown a.c. voltage. The a.c. voltage brought out at the bottom of the front panel is from one of the 6.3 volt filament windings; although its r.m.s. value is 6.3 volts, its peak-to-peak value is 17.8 volts or, roughly, 18 volts. We can, by holding a ruler against the front of the C-R tube, adjust with the *Y* axis gain control this waveform to exactly one inch in height. By measuring the height of an unknown voltage with the ruler we can determine the value of an unknown voltage. Remember that the peak-to-peak value (distance from top of positive peak to bottom of negative peak) of a sine wave is 2.82 times the r.m.s. value. The *Y* axis amplitude control must not be touched after the calibration is made or the calibration will change. If the unknown voltage is greater than can be measured on the 3" tube with an 18 volt per inch sensitivity then set the 18 volts equal to ¼ inch, etc.

If we want to measure a d.c. voltage, then the jumper on the *Y* axis deflection plate at the back of the scope should be removed and a known d.c. voltage applied directly to the plates. The spot will move to a new position and remain there. The distance is measured and then the distance an unknown voltage moves the spot is measured and compared with the calibration distance. If a very large voltage is to be measured, a voltage divider of very high resistances should be placed across it. The resistance values should be accurately known. 5% carbon resistors will suffice in most instances if their wattages are not exceeded.

To find an unknown frequency, one has several choices. First, you can compare it with the frequency calibration of the internal sweep by turning the sweep knob to minimum and adjusting the sweep frequency knobs until one cycle appears on the screen. This is a rough frequency determination, but will suffice in some cases. To more accurately determine the frequency, compare it with a known fre-

quency from the 60 cycle line frequency, an audio oscillator or a signal generator. If neither of the latter is available there are a few common sources of known frequency. The output from a full-wave rectifier is 120 cycles per second. WWV, the standard frequency station, broadcasts a 440 cycle note and a 4000 cycle note on exactly 5 megacycles, which can be picked up on all-wave superheterodynes.

The unknown frequency is introduced into the *Y* axis amplifier. The known frequency is applied to the *X* axis amplifier by switching the *X* axis switch to external and turning the sweep frequency switch to the off position.

The modulation envelope of a phone transmitter may be observed by applying some r.f. from a coupling coil placed in the field of the transmitter's tank coil directly onto the vertical deflection plates. Distortion in audio amplifiers is easily located and eliminated.

Receiver signal tracing is possible with the scope, and the location of noise and intermittents is also possible. Receiver alignment is best done with a scope, and requires an oscillator which has its frequency swept through an adjustable range. There are several sweep frequency signal generators available on the market, as are frequency modulated signal generators. These generators also generate a sweep which is applied to the *X* axis of the scope.

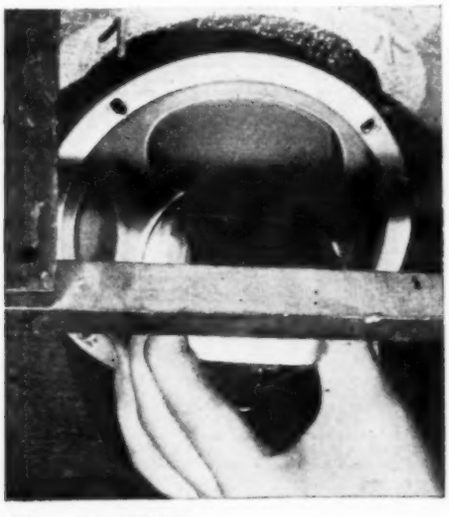
There are a host of other uses for your scope which you will discover as you use it. There is no substitute for this convenient window through which you can actually see what is going on in a circuit.

—30—

STUDS MAY DAMAGE SPEAKER CONE

RADIO speaker cones are often damaged by piercing the cone with the sharp end of the mounting studs when removing or replacing the speaker.

Grasp the speaker as shown and guide it carefully into place—keeping the mounting studs lined up with the holes in the speaker rim—to avoid damage to the cone. . . . . H. L.



Technical BOOKS

"THE PEOPLE LOOK AT RADIO" by Paul F. Lazarsfield and Harry Field. Published by *Chapel Hill, The University of North Carolina Press.* 151 pages. Price $2.50.

This book covers the results of a survey made by the University of Denver's National Opinion Research Center at the behest of the National Association of Broadcasters. The findings were later analyzed and interpreted by the Columbia University's Bureau of Applied Science. These results are incorporated in this report to the broadcasters from the American people.

Several surprising results were discovered in the course of this survey. If you are a "commercial hater" you are definitely in the minority. 62 per-cent of the people polled expressed their preference for radio programs *with* advertising; 35 per-cent wanted their program material without product plugs, while 3 per-cent had no opinion on the subject.

Many other interesting facts about the part radio plays in the instruction, education and entertainment of the public are included in this book.

* * *

"THE DECIBEL NOTATION" by V. V. L. Rao. Published by *Chemical Publishing Company,* Brooklyn, New York. 176 pages. Price $3.75.

Since the "decibel notation" was first used in 1924 in connection with telephone engineering there has been no text in the English language which made any attempt to explain the origin, development and applications of decibel notation until the appearance of Mr. Rao's book.

In covering his subject, the author has delved into the development of the logarithmic unit, zero levels and level signs, decibel meter and decibel graphs, sound levels and phon calculations.

Technical personnel in the radio and acoustics field should find this book of great assistance in their work. The many graphs and tables which are used extensively throughout the text material have many practical applications.

—30—

ERRATUM

It has been brought to our attention that on page 12 of the January issue in "Spot Radio News" we were guilty of giving away fourteen minutes of Station WQQW's time to free advertising messages. The sentence should read "No commercials will be permitted longer than one minute" says station policy. "At least fourteen minutes free of advertising will precede and fourteen minutes free of advertising will follow each commercial." Our apologies to Station WQQW.

Photo Credits

Pages	Credit
(Cover Photo)	Black Box Studios
35 (left)	Sperry Gyroscope Co.
35 (center)	General Electric Co.
35 (right)	Raytheon Mfg. Co.
46	Walter Steinhard, Staff Photographer
48, 49, 140	Radio Corporation of America
57	The Hallicrafters Co.
58	Aviola Radio Corp.
62	"The Oregonian"
102	Barker Bros.
134	Station PCJ, Holland

Classified

Rate 20c per word. Minimum 10 words.

RADIO ENGINEERING

SLIDE Rule Short Cuts, with Positive location of the Decimal Point. Easier, Quicker AC-DC calculations. Nothing else like it. Second Edition —$1.50 postpaid. W. P. Miller, 536 "F" St., San Diego 1, Calif.

RADIO Engineering Broadcasting, Aviation and Police Radio, Servicing, Marine Operating and Electronics taught thoroughly. Expenses low. Write for catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

MAGNETIC Wire Recorder: Magazine with 10,000 feet stainless steel wire, contains recording, reproducing and erasing heads with level-wind control, two spools with automatic brake and high speed rewind. Switches for warning, stop and overrun. Add your motor and amplifier and make 8000 cycle recorder. Brand new—made for Government and in original packages. Price, while they last, $15.00. Sent COD with $5.00 prepayment. Rotary Beam Antenna Motors: reversible, geared-head motor, can operate 200 lb. beam, 1½ and 3 R.P.M. torque 75 in. lbs. 12 volts D.C.—Operate from A.C. with transformer and dry disc rectifier. Relays and switches built-in. Made for Government, cost $115. Our Price, while they last, $5.50. Sent COD with $3.00 prepayment. Radioco, 1110 Marshall Bldg., Cleveland, Ohio.

SPEAKER Cones replaced, prompt service, satisfaction guaranteed, 3, 4, or 5 inch, $2.25; 6 inch, $2.75; 8 inch, $3.25; 10 inch, $4.50 up; 12 inch, $4.95 up. National Radio Distributors, 899 Southern Boulevard, New York City 59, N. Y.

QSL CARDS that stand out! Individualized, original cartoon by W2EA (ex-8EA) incorporating your ideas, personality, etc. Reasonable, but not cheap. Send stamps for specimens. Harrison Radio Corp., 9 West Broadway, N. Y. C.

ONE complete No. 19—Mark II Tank—transmitting and receiving set. Or will trade for good radio test equipment or new bicycle parts. J. C. Stradley, 15 Rice St., Hamlet, N. C.

25 MODEL 1100-A Karadio medium frequency nine tube crystal controlled mobile radio receivers. Tuning range 2 to 3 megacycles. Complete with tubes and crystal for operation on 2726 kilocycles. In good condition. 3 Temco model 25A-IF, 25 watt output, mobile transmitters. Tuning range 2 to 3 megacycles. Tubes—6L6-Oscillator, 2/807-final, 6C5-amplifier, 6N7 driver, 2/6L6-modulators. Dynamotor power. Fair condition. For operation on 2726 kilocycles. 1 Kaar model PTL-22X, 22 watt output, mobile transmitter. Tuning range 2 to 3 megacycles. Tubes—HY-69-oscillator, HY-69-final, 2/HY-69-modulators. Dynamotor power. For operation on 2726 kilocycles. In excellent condition. 1 General radio model 775-A frequency monitor. Complete with tubes and crystal for monitoring 2726 kilocycles. New, in excellent condition. For sale by Southern Natural Gas Company, P.O. Box 2563, Birmingham, Ala., % Lucien C. Bomar.

STOP That Hum! Rubling, blasting and tearing with "Voicoil" solution. Large bottle, treats 12 cones, $1.00 postpaid. Lasts for years. Saves repairs. Radio Research Products, W. Malloy, Mgr., Room 29, 1230 E. 63rd St., Chicago, Ill.

DUAL microammeter, 200 microamps each, 3¼" diameter Westinghouse, $3.50. 1-0-1 milliammeter, 2⅜" diameter, $2.00. Oil filled capacitors, .25 mfd, 4000 WVDC, 85c. 3" Cathode ray scope, radar indicator ID-93/APG-13A, 115v 400cps, complete with 11 tubes, new, $25.00. Write for list. Rubin Radio, Shrewsbury, N. J.

SX-28A HALLICRAFTER in A1 condition, $190. S. Palasek, 62 Main St., Port Washington, N. Y.

ERECO Beam Rotator. High torque output 1-3 RPM. Selsyn indicators, attractive control panel. Reversing switch. Watertight. 110VAC operated. Models from $37.50 to $50. Build your own kits from $17.50 to $25.00. Write for Photos, Literature. Dealers' inquiries invited. Manufacturer Ereco, 1006 Hewitt, Everett, Washington.

DYNAMOTORS. Transmitting, SCR 274, DM 33's; 28 volts input; 575 Volts @ 160 Ma. output. Reconditioned and guaranteed. $4.65 each; $3.65 in lots of three. 25% deposit on C.O.D.'s. Airborne Communications, Inc., Lunken Airport, Cincinnati 26, Ohio.

JENSEN JHP-52 Speaker, Cabinet, Amplifier, practically new. Earl H. Swen, Gilby, N. D.

3 EACH Navy QBG Underwater Echo Ranging and Listening Equipment complete with spare parts. $75 Each. F. Harrison, 506 5th Ave., Asbury Park, N. J.

NEW Bell amplifiers, systems. Free List. B and B Sound, Sheboygan, Wis.

SIGNAL TRACER: Save $17.45. I'm closing shop. Will sell brand new SPECO Model STAP AC-DC for $27.50. Cost me $44.95. Send check, money order or C.O.D. to M. H. B. Hoffman, 4112 Gallatin St., Hyattsville, Md.

A. 4-TUBE video amp. chassis—Contains valuable ceramic sockets, terminal strips, chokes, condensers, etc. Real buy for the amateur. $2.50. B. Complete well filtered DC power supply conservatively rated at 375V-140 mils—Features two CD 16 mfd.-600V. filter capacitors and separate 6.3V. filament supply. Uses two 6x5's—Connections are brought to terminal strips, less tubes, $5.95. C. Westinghouse Oil filled Condensers, 10 mike 600WV, rectangular can, $2.50. D. 5" P.M. Speaker, Magnet 2.15 ounce, Alnico #5, $1.59. Belmont Radio Supply, 1921 Belmont Ave., Chicago 13, Illinois.

FREE wholesale bulletin, Tubes, parts. Bargain prices. Henshaw Radio Supply, 3313 Delavan, Kansas City, Kansas.

SELENIUM Rectifiers, full wave, ½ ampere, $1.85; 1 ampere, $2.50. Half wave 5 amperes, $4.50; 2.2 amperes, $2.25; 1.5 ampere, $1.85. Bulletin. Bursma Radio, Route 5, Grand Rapids, Mich.

LOWEST Prices. Radio Tubes, parts. Bargain lists 3c. Potter, 1314 McGee, Kansas City 6, Mo.

RADIO Tubes—Dealers, order your needs—be surprised at prices. Address Radio Tubes, Box 108, Elizabeth City, N. C.

RECORDING Discs: Presto's famous 16" green label double face glass base recording blanks, only $1.35 each, guaranteed perfect. Recording Specialties, P.O. Box 84, St. Albans, New York.

WANTED

HIGH grade Frequency Meter, Low resistance bridge, and resistance standards. Henry Wagner, 4411 Indianapolis Blvd., East Chicago, Indiana.

RIDER Manuals Wanted, 1 to 5. Write A. Lopes, 780 E. 214 St., New York City.

HALLICRAFTER SX-28A or SX-42. Dr. M. E. Tate, Somerset, Ky.

ATTENTION Manufacturers! Wanted three tube superhet (12SA7, 12SQ7, 70L6). Three band (.15-.40, .55-1.5, 6-20 MC). IF 455. Dial printed well-known European stations. Phono connection. Line voltage 110. Lots of thousands. Interested also for other small types and parts. Mors Telsiz Atelyesi, Sisli P.K. 66, Istanbul, Turkey.

CORRESPONDENCE COURSES

USED Correspondence Courses and Educational Books Bought, Sold, Rented; Free Catalog. Educational Exchange, Henagar, Ala.

CORRESPONDENCE Courses and self-instruction books, slightly used. Sold. Rented. Exchanged. All subjects. Satisfaction guaranteed. Cash paid for used courses. Complete information and 100-page illustrated bargain catalog FREE! Write Nelson Company, Dept. 59, Chicago 5, Ill.

AMATEUR radio licenses. Complete code and theory preparation for passing amateur radio examinations. Home study and resident courses. American Radio Institute, 101 West 63rd Street, New York City.

USED Correspondence Courses and Educational Books sold or rented. Inexpensive. Money-back guarantee. Write for Free Catalog listing 4000 bargains. — (Courses Bought.) — Lee Mountain, Pisgah, Ala.

PATENT ATTORNEYS

PATENTS—U.S. and Foreign Patents Secured. Trade-marks and Copyrights registered. Searches made to determine Patentability and Validity. Patent, Trade-mark and Unfair Competition Causes, Lancaster, Allwine & Rommel, Registered Patent Attorneys, Suite 414, 815 15th St., N.W., Washington 5, D. C.

INVENTORS—Steps to be taken in obtaining patent protection available upon request. Victor J. Evans & Co., 248-C Merlin Bldg., Washington 6, D. C.

SITUATIONS WANTED

EX-CHIEF Radio Operator Merchant Marine, First Class Radiotelegraph, Second Class Radiotelephone. Five years' experience, age 27, Draft classification 1-G, desires job with future. Harold Cantor, 99 Brainerd Rd., Allston, Mass.

NAVY trained radar-radio technician-engineer with M.A. degree wants position. Box 443, % Radio News.

HELP WANTED

JOBS With a Future. Foreign and Domestic positions await interested persons. 1947 Copyrighted listing covering thirty Major Fields only one dollar to sincere applicants. Boston Trading Company, Box 332, Boston 1, Mass.

MISCELLANEOUS

FRENCH radio businessman, reliable, competent, first class references, wishes to represent American radio firm in France. Write to Louis Matigot, 50 North Drive, Huntington Station, N. Y.

RAILWAY telegraphy. Be a railroad telegrapher. Operators are in great demand. Salaries from $3,200 up. For information write to Bell Telegraph Ry. Institute, 10 Parker Ave., Suite 9, San Francisco 18, Calif.

GUARANTEED Wholesale radio repairs. Just send us the radio prepaid, we repair and return C.O.D. 24 hours' service. We fix them all. Akerberg Radio Laboratories, Stanley, N. D.

WHOLESALE Radio Service at reasonable rates, quick service, no job too big. Write for full information. Elkins Radio, Elkins, W. Va.

ELECTRICAL instruments. Meters repaired and converted. Inquiries solicited. Haledon Electrical Instrument Co., 319 Belmont Ave., Haledon, N. J.

CUSTOM Built Equipment for less than "factory-built" prices! How? Write Custom Equipment Laboratories, Box 623, Cedar Rapids, Iowa.

25 YEARS' experience in radio repairing at your fingertips for $1.00. I've repaired 45,000 radios and have perfected a system which you can follow step by step. My methods are far simpler than any other course on the market and requires no calculations. Send $1.00 to Ross Radio Company, Dept. C, 14615 Grand River, Detroit 27, Michigan.

INDEX OF ADVERTISERS

March 1947

Look for this symbol of PREMIUM QUALITY

APPROVED PRECISION PRODUCTS

Your guarantee of PERFORMANCE *at no extra cost*

The words "Approved Precision Products" on a Mallory box mean something more than an advertising slogan. They're your guarantee of *premium quality*—a guarantee backed by fifteen years of performance.

They're reminders that more Mallory-made vibrators are in use today than all other makes combined . . . that Mallory capacitors are universally preferred because they're backed by the most rigid purity-control standards in the industry . . . that Mallory resistors, fixed and variable, are justifiably famous for closer tolerances, extra dependability.

"Approved Precision Products," too, mean a *complete line* of parts—parts that are sold through carefully-selected, conveniently-located distributors with the *capacity* and *desire* to serve you well. Look for the words "Approved Precision Products." They're not a symbol of higher cost—just that

YOU EXPECT MORE AND GET MORE FROM MALLORY

P R MALLORY & CO Inc

MALLORY

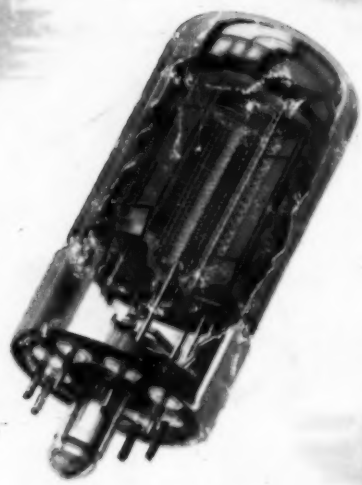
VIBRATORS . . . VIBRAPACKS* . . . CAPACITORS . . . VOLUME CONTROLS . . . SWITCHES . . . RESISTORS . . . FILTERS . . . RECTIFIERS . . . POWER SUPPLIES.

*Reg. U. S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, IND.

FOR A GREAT PERFORMANCE—



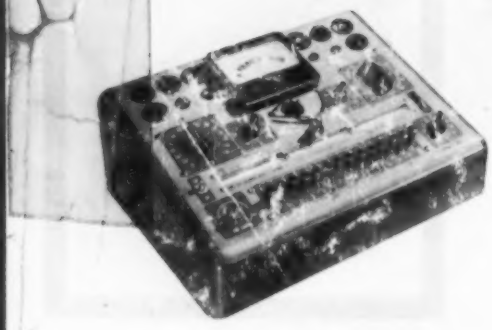
—THE HIGH AND MIGHTY SYLVANIA *Lock-In* TUBE!

If you're looking for a tube that's small, compact . . . of extreme strength . . . easily able to handle ultra-high frequencies — then your search is ended. Installing Sylvania's famous Lock-In Tube into your radio set — FM or television equipment — assures superior performance.

And no wonder . . . for, into every phase of the development of this tube has gone the finest in engineering skill. Each part of the Lock-In has been tested and retested, assuring a finished product of unsurpassed quality.

The next time you buy, insist on the Sylvania Lock-In Tube. Rely only on the best. Meanwhile, check these outstanding electrical and mechanical advantages:

Lock-In locating plug . . . also acts as shield between pins. Short, direct connections . . . fewer welded joints —less loss. Getter located on top . . . shorts eliminated by separation of getter material from leads. No top cap connection . . . overhead wires eliminated. Reduced overall height . . . space saving. Stays put in mobile and portable rigs.



AND HERE'S THE LAST WORD in tube testers—another outstanding product of Sylvania Research. Like the Lock-In, the Counter Tube Tester (shown) embodies the finest in engineering and styling.

All controls easily set for each tube to be tested. Little or no special knowledge required for operation. Designed with extra sockets and switch contacts for easy modernization. This unit is the sign of a progressive establishment.

SYLVANIA ELECTRIC

Emporium, Pa.

ERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT